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Analysis of some of the Anthracites and Iron Ores found on the head waters of Beaver Creek; in the counties of Luzerne, Northampton and Schuylkill, Pennsylvania. By WALTER R. JOHNSON, *Professor of Chemistry and Natural Philosophy in the Medical Department of Pennsylvania College, Philadelphia.*

In the course of some examinations in the summer of 1838, of the coal field lying partly in the county of Luzerne, and partly in Northampton and Schuylkill, I was, among other objects of interest, led to observe the explorations then in progress on the lands belonging to the Summit Coal Company and others, lying on the head waters of Beaver Creek, adjoining the property of the Beaver Meadow Coal Company.

As the facts presented by those explorations appeared to afford solutions of certain questions relative to the position of the coal beds in that neighbourhood, I was induced to make a collection of such of the minerals as appeared important in that view, as well as indicative of the value of the coal for economical purposes.

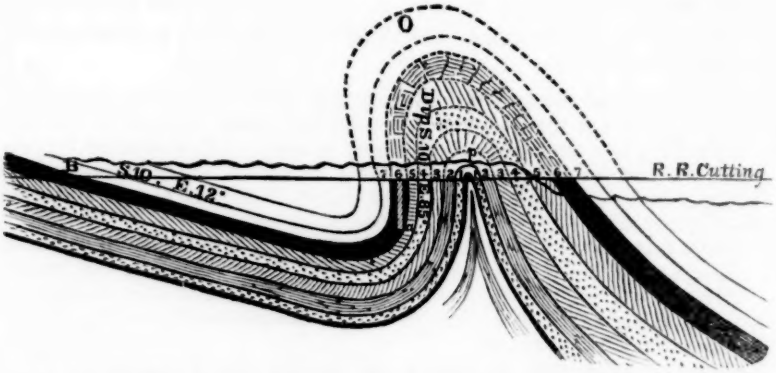
I should premise that the lands of the Summit Coal Company are situated mainly on a swell or bluff of land, lying between Pismire mountain on the north, and Spring mountain on the south, forming near its eastern extremity a tapering ridge or "*point hill*," between the north and south forks of Beaver creek; and at its western termination constituting a kind of table land, nearly as high as the tops of the two mountains above mentioned.

The circumstance in the character of the formation just referred to, is the general conformity of position in the coal beds in this part of the coal field with the prevailing figure of the surface of the ground. This is indicated first by the southerly dip of the beds on the south slope of Pismire hill and north of Beaver creek;—secondly, by the northern inclination of them where exposed on the north slope of the summit bluff;—thirdly, by the horizontal position found to prevail on the summit of the bluff; and

finally, by the southern dip exhibited on the south slope of that bluff, to which may be added the northerly inclination of the strata in Spring mountain on its northern side.

The following sketch illustrates the view above given, and as it is derived from actual inspection and measurement of the coal strata, where they are exposed to view in a cutting formerly made for the railroad leading to the mines of the Beaver Meadow Coal Company, affords direct proof of the existence of more than one flexure in the Beaver Meadow coal trough. In this cutting there is displayed a nearly vertical bed of coal more than thirty feet in thickness; having, however, a real position or dip S. 10, E. 85°, and consequently a course or "strike" N. 80° E. In sinking a shaft in this vertical vein to a depth of 60 or 70 feet, it was ascertained that the inclination was changed to a northern dip; and the southern inclination at the surface of the ground was observed to continue southerly for one or two hundred yards, to a point where a thin seam of coal is seen to be cut through ust at the level where it comes to an upward flexure, and after passing to the south of that flexure, the whole series of rocks recurs in an inverse order from that which had been observed in approaching it. The dip also changes at this point from 85° to a much lower southerly inclination.

The doubling of the strata together is thus indicated, and the flexure of the large vein now worked, as exhibited from B to *a*, is rendered highly probable. The faintly marked portion of the figure between O and *p* represents the supposed portion of the upward flexure which has been carried away by denudation.



Coal.—1. The *first* specimen of the coal was taken from the opening not far from the State road, on the summit of the bluff or central ridge, on which the lands of the summit company are mainly situated. It is compact and shining; the black colour slightly inclining here and there to blue-black; the surfaces of deposition nearly obliterated, and the cleats or slines which generally part coal vertically, scarcely, if at all, perceptible. Hence the direction of the fracture appears indifferent, taking place in various ways promiscuously, with a form mostly conchoidal. Slight traces of iridescence are occasionally seen, indicating the presence of minute portions of protosulphuret of iron.

Its specific gravity is . . .	1.613
It contains of water, ...	3.43 per cent.
Gaseous matter volatile at bright red heat, .	4.08
Carbon not volatile by simple heat, . .	87.48
Earthy matter, ...	5.01
	100.00

The ashes are of a fawn colour, of medium density, and contain the following ingredients in 100 parts, viz:—

Silica, ...	54.50 per cent.
Alumina, ...	34.45
Peroxide of Iron, ...	7.50
Lime, ...	2.25
Magnesia, ...	1.30
	100.

Having been taken from near the outcrop of the bed, this specimen is to be regarded as a rather less favourable sample than would be probably found under a greater depth of covering.

2. The next specimen analyzed was from the northerly slope of the bluff, also near the State road. In many of its external characters it resembles the preceding, but is less prone to give conchoidal fractures, and its specific gravity is 1.594.

It contains of water, ...	3.26 per cent.
Other matter volatile at red heat . .	1.05
Carbon, ...	91.69
Earthy matter, ...	4.00
	100.00

The ashes of this specimen were likewise analyzed, and gave the following result, viz:

Silica, ...	50.25
Alumina, ...	38.90
Peroxide of iron, ...	8.75
Magnesia, ...	1.25
Lime, ...	0.85
	100.

3. The third variety of this coal which was subjected to analysis, came from an opening which was in progress at the period of my visit to the Beaver Meadow. It was taken from a shaft then sunk fifteen feet in a bed composed partly of black dirt and partly of solid coal. The sample was taken from the solid part near the bottom. It is like the foregoing in regard to the obliteration of its surfaces of deposition, has rather less of the bluish tinge in its colour, possesses a specific gravity of 1.630, and will consequently weigh 2750¾ lbs. per cubic yard, or nearly 1¼ ton.

It contains of volatile matter,	9.6	per cent.
Carbon not volatilizable by simple heat,	85.337	"
Earthy matter,	5.063	"
	100.	

The ashes of this coal are likewise reddish-gray, varying but little in complexion from the preceding. The combustible *gas* given out in the distillation of this coal is of considerable amount, and indicates it as a fuel well adapted for use under steam boilers.

4. The *fourth* variety tried was taken from a pit on the north side of Beaver creek, and appears to be the third coal bed in the formation, reckoning from below, upwards. The inclination of this bed is to the south, and it accordingly dips under the bed of the creek. It is ten feet or more in thickness, and presents highly favourable indications as to facility in working. Its colour in fresh fractures is jet-black, shining. The form of fracture irregular, splintery; a striated appearance being occasionally observable.

Its specific gravity is 1.560. A cubic foot of it therefore weighs 97½ lbs. and a cubic yard 2632½, or about 1⅛ ton. Of this coal two analyses were made. By the first, I obtained of volatile matter, including

Water and combustible gases,	6.89	per cent.
Carbon, not volatile by simple heat,	91.64	
Earthy residuum,	1.47	
	100.00	

The ashes are of a brownish-red colour, tolerably heavy, and have all the appearance of being derived from a regular *red-ash* coal.

The unusually small proportion of the earthy residuum given by the above trial, having induced me to suspect that some error might have occurred and escaped notice, I repeated the trial with the utmost attention, taking care to determine, separately, the water and gaseous combustible matter. From this repetition, I obtained,

Volatile matter, 6.42 per cent.	Water,	2.19	per cent.
	Gas, (carbonic oxide, carburetted hydrogen, and a little tar,)	4.23	
Unvolatilizable carbon,		92.30	
Earthy residuum,		1.28	
		100.	

From this it appears that the first trial on this sample was not certainly below the truth in regard to earthy matter.

The diversity between the two experiments is not so great as will often occur in trying specimens from the same coal bed. Either may be regarded as highly favourable to the character of the coal. I may be allowed further to remark, that of all the trials of anthracites of which I have any knowledge, either by my own experiments or those of others, the analysis just detailed, gave the least proportion of earthy matter, and even of bituminous and cannel coals, I have met with but one result among the many on record, which was even so low in the amount of its earthy impurities;

and yet I have no reason to believe that the sample which I picked up at random at the mouth of the pit, was of better quality than the average of the mass from which it was taken.

If the four varieties of coal be viewed together, ranged in the order of their specific gravities, beginning with the lowest, we have the following table of results :—

	Sp. gr.	Vol. mat.	Carbon.	Ashes.
1st. (No. 4.)	1.560	6.42	92.30	1.28
2d. (No. 2.)	1.594	4.31	91.69	4.00
3d. (No. 1.)	1.613	7.51	87.48	5.01
4th. (No. 3.)	1.630	9.60	85.337	5.063
Mean . .	1 599	6.96	89.452	3.838

From the above table, it will be perceived that the quantity of ashes increases as the specific gravity increases, and that the quantity of fixed carbon diminishes as the specific gravity increases. This might possibly not be found to hold good in all coal-fields, though I am inclined to think that in the same coal-field the relations of different plies will be found to confirm the same general law.

In comparing the results in the above table with those of other experiments on anthracite, I find the average amount of carbon much greater than has heretofore been assigned to that species of fuel.

Thus of twelve species of anthracite analyzed by Berthier, the mean per centage of carbon was 79.15
Ashes, ... 13.25
Volatile matter, ... 7.37—99.71

It hence appears that while the quantity of volatile matter is widely different from that which I find as the average amount of the same material in the coal of the Summit Company, the proportion of ashes is nearly three-and-a-half times as great.

By a mean of seventeen trials on the coal of different beds at Tamaqua, Messrs. Bache and Rogers found the proportion of ashes 7.3 per cent., or a little less than twice as much as the average of my four analyses of the *summit* coal of Beaver creek.

No. 5. This specimen was taken from a pit opened on the lands of Cornelius Stevenson, Esq., on the northerly slope of the bluff above described, but not far from the top of the ridge. The bed has at this point a northerly dip, and consequently confirms the view above given in regard to the general arrangement of strata.

The coal is compact, shining, of a bluish-black; its specific gravity is 1.6127; a cubic foot of it will weigh 100.79 lbs., and a cubic yard 2721$\frac{1}{2}$ pounds.

When heated to redness, the specimen which I analyzed, and which was taken from the bed only a few feet from the surface of the ground, or outcrop of the coal, and was consequently more charged with moisture than the generality of the coal would be, gave of water at 550°, 5.68 per cent.

Combustible carbonic oxide, and a little carburetted hydrogen expelled at red heat, ... 3.55
Carbon, not volatilizable by simple heat, . . . 86.06
Earthy matter, ... 3.71
100.00

The ashes of this coal are of a salmon colour, moderately light, and contain the following proportions of their several ingredients, viz:

Silica,	50.05	per cent.
Alumina,	29.04	"
Peroxide of Iron,	8.75	"
Lime,	1.56	"
Magnesia,	1.30	"
	99.70	

The small proportion of earthy matter found in this coal, with the very slight trace of sulphur observable during the combustion, mark it as properly adapted to the purposes of the founder and iron manufacturer, as well as to domestic consumption. I see no reason to doubt, that in all respects it will bear a favourable comparison with the best varieties of coal found in the district of country in which it lies. Few, if any, anthracite districts have fallen under my observation, which possess a less share of earthy ingredients. And viewing its relation to the anthracites of other countries, we may state that of twelve varieties of that fuel analyzed by M. Berthier, the result was found to be

In *Carbon*,	highest .913	lowest, .665	mean, .791
In *Ashes*,	" .249	" .027	" .732
In Vol. mat.	" .135	" .022	" .073

No. 6. This specimen of coal was from the lands of the Buck Mountain Coal Company, near the head waters of Laurel run, and at a distance of about five miles from the locality of those above described. It is in fact in the prolongation of that coal trough, in which the Hazleton and Sugar Loaf mines are situated, and is near the south-eastern extremity of the deposite. The bed there dips to the north in an angle of about fourteen degrees.

This sample came from the bed twenty-two feet in thickness, lying thirty or forty feet above the conglomerate rock which appears to be the boundary of the coal formation, and from the lowest ply, except one, in that bed. The thickness of this ply is over seven feet. The distance from the point where the mine is open, to the mouth of Laurel run, down which stream the course of a railroad leading to the Lehigh would lie, is about four miles.

The coal is compact, and of a nearly uniform black colour; shining; fracture uneven, splintery, indifferent in its direction, and seldom conchoidal in its form. Though the surfaces of deposition are discernible by the differences of colour, there appears to be no tendency to cleavage in the direction in which they traverse the coal. Its specific gravity is 1.559, and consequently one cubic yard will weigh 2630 pounds.

Its constituents are,—*water*,	0.390	per cent.
Gaseous matter, including some azote, volatile at bright red heat,	5.515	"
Carbon, not volatilizable by heat,	91.016	"
Earthy matter and oxide,	3.079	"
	100.	

The ashes are of a reddish-buff colour, rather light, and present some

portions perfectly white. They yielded on analysis the following constituents, viz:

Silica,	45.60	per cent.
Alumina,	42.75	"
Peroxide of Iron,	9.43	"
Lime,	1.41	"
Magnesia,	0.33	"
	99.52	

The proportion of ashes in this coal is much below that of the average of the anthracites of Pennsylvania. Few even in that part of the central coal district, in which the Buck Mountain Company's lands are situated, will be found to yield either less earthy matter, or more fixed carbon, than the sample above analyzed.

Iron Ores.—The bed of iron ore from which the samples that I have examined were taken, is found on the southern declivity of the bluff, about forty rods northerly from the south fork of Beaver Creek, and judged to be about three-quarters of a mile from the Beaver Meadow Rail-road. With this road the locality can be connected at a very little expense by a branch road. Above the bed of ore is a seam of black dirt of considerable thickness, judged to be the remains of a bed of coal which may possibly be found unaltered at no great distance.

The thickness of the bed of ore and shale is seven feet, and it lies seventeen feet beneath the surface of the ground at the point where it is opened. The inclination of the bed is to the south, but apparently less rapid than that of the surface of the hill, so that if the dip observed in the shaft be maintained for any considerable distance below the present opening, there is reason to suppose that it would *crop out* before coming to the border of the creek. The covering is composed of

3 feet of Earth—surface soil,
6 " Black Dirt,
8 " Slate,
7 " *Ore* and Slate,
1 inch of Coal,
17 feet of Sandstone.

The first variety which was analyzed gave by the usual assay in the dry way, the following composition, viz:

Water expelled at 250°,	00.4	per ct.
Carbonic Acid,	26.6	"
Cast Iron,	33.8	"
Earthy matter,	26.64	"
Oxygen,	12.55	"
	99.99	

This variety of the ore has a light bluish ash colour, is moderately tough before calcination, and possesses a specific gravity of 3.247; consequently, a cubic yard of it would weigh 5469 lbs. or 2.44 tons.

The pig metal given in the above assay is soft, tough, and of a dark gray colour, apparently well suited for foundery purposes.

The cinder is a transparent, nearly colourless, glass,—very fusible and contains but few adhering particles of metal.

The employment of pure carbonate of lime as a flux in the proportion of

one part of this metal to six parts of raw mine will produce a complete reduction of the ore and fusion of the earthy ingredients. In using the anthracite No. 5, above described, a small addition of limestone, to the amount of one per cent. of the coal employed, may be found requisite in order to insure an equally complete fusion of the earthy residuum of the fuel. Assayed in the humid way this ore yields the following results, viz:

	per ct.
Water,	00.40
Carbonate of Iron,	63.20
Carbonate of Lime,	2.50
Carbonate of Magnesia,	2.27
Oxide of Magnesia,	2.00
Silica,	17.50
Alumina,	10.55
	98.42

The above quantity of carbonate corresponds to 39.1 per cent. of protoxide, or 30.45 per cent. of pure metallic iron which is 3.35 per cent. below the above yield in *pig metal*, or it is 9.9 per cent. of the pig metal itself, to be regarded as pure iron matter; which is probably very near the true average amount according to the latest and best analyses. The yield in *iron* is equal to the average of Scotch ores in the neighbourhood of Glasgow.—The latter have a specific gravity of 3.209, according to Dr. Colquhoun. This ore which is the blue clay iron-stone of the coal measures, has therefore the specific gravity, the degree of richness, and the fusibility of the same class of ores found in bituminous coal fields, and there is no doubt, in my mind, that it may be easily and profitably worked.

The second variety of the ore examined, was a sample from the same locality, but from a different part of the bed from that in which the preceding was found. It is of a reddish-brown colour, except the exterior, which is yellowish-red.

The specific gravity of this variety is 2.896.

Assayed in the dry way it gave,	*Water*,	13.12 per cent.
	Pig metal,	44.96 "
	Earthy matter,	24.804 "
	Oxygen,	17.11 "
		99.994

Of the earthy impurities, there were found insoluble in acids 18.55 per cent. The ore now under consideration, has apparently undergone a change by atmospheric influences, from the condition of a carbonate of the protoxide of iron to that of a hydrate of the peroxide; it is not remarkable that in passing from one of these states to the other, some of the earthy ingredients should have been washed away. The usual tests of lime failed to detect that substance. The cinder had a smoky-gray colour, translucid on the edges, and was a compact glass, moderately fusible.

As the appearance of the cinder indicated, particularly when tested before the blow pipe, and by acid, that some portions of metallic oxide still remained in it, an analysis of this ore was also made in the humid way, which gave the following results, viz:

Water,	13.12	per cent.
Peroxide of Iron, with trace of manganese,	63.65	"
Silica,	13.45	"
Alumina,	8.77	"
Magnesia,	1.01	"
	100.	

The quantity of peroxide of iron corresponds to 44.55 per cent. of *iron*, or .41 per cent. less than that of the metal actually obtained. Hence it appears that the quantity of iron remaining in the cinder is very nearly equal to that of the carbon, &c. in the pig metal.

There seems, from all the above statements, to be no reason to doubt that when brought into use, this ore will prove every way competent to sustain a character equal to that of any other argillaceous carbonate of iron, whether of the bituminous, or the anthracite coal districts. I am not aware that the samples which I took from the mouth of the pit were other than fair representatives of the general character of the bed from which they were raised. It is probable that when explored so far as to be under an extensive solid covering, it will be found to correspond more nearly to the character indicated by the former than to that given by the latter of the above analyses.

Near the second bed of coal opened on the slope of the hill north of the northern branch of Beaver creek, I found some iron ore thrown out in excavating a coal shaft. It was all in the state of brown hydrate, and though too much exposed near the surface to allow of the formation of any just estimate of its quantity in the solid part of the bed, where, doubtless, it will be found in the state of a carbonate, yet the size of the specimens which I observed, and their structure, led me to suppose that it could not belong to a trivial, or chance, deposite. This opinion is strengthened by the fact that a bed of seven feet in thickness of iron ore and iron slates is found, as already described, on the opposite side of the bluff, and not more than a mile distant.

The ore submitted to analysis, is of a brown, or yellowish-brown. colour, compact, with small shining particles. Its specific gravity is 3.555.

At a temperature of 330° it loses in moisture,	0.55	per cent.
By strong calcination, it loses of water,	10.048	"
It contains of Peroxide of iron,	71.12	"
Earthy impurities,	18.382	"
	100.	

Of the earthy matter, 13 per cent. are insoluble in acids, being chiefly silica, and 5.382 per cent. are alumina and magnesia; no lime was detected; and but a trace of manganese.

The quantity of pig metal obtained in my analysis was 49.77 per cent.; its colour dark gray; structure crystaline, granular. It was soft, tough, and well adapted for foundery purposes. The cinder was a perfect glass, translucent on the edges, of a smoky colour, readily fusible before the blow-pipe, and, consequently, it presents no obstacle to the free running of iron in a furnace. The result of this trial is such as in my opinion, to justify a careful examination to ascertain the quantity of ore to be obtained in this locality. Being in the immediate vicinity of the richest of the

coals above described, it will be a highly valuable resource, if it shall be found in beds of such thickness, and with such accompaniments, as to render its attainment not too expensive. This point will be determined only by actual searches.

Notice of the advances made in the Science of Mineralogy during the year 1837. *From the Report of Berzelius to the Swedish Academy.*

(Continued from page 221.)

On Minerals already known.—In the year 1760 was discovered, in the ground on which the city of Montpellier is situated, metallic mercury, and as this did not agree with the opinions respecting its ordinary localities, recourse was had to the absurd explanation, of its originating from the large amount of mercurial preparations employed for the syphilitic diseases in the Hospitals. *Marcel de Serres* has proved* that mercury occurs not only in the strata under the town, but in those of the neighbourhood, and thinks that the barrenness of the soil may be attributed to this cause. It does not exist in the uppermost stratum, which consists of sea sand, and incloses organic remains; but under this, and resting upon a tertiary lime-stone, is a stratum of yellowish, argillaceous marl, in which globules of the metal are sparsely distributed, without a trace of cinnabar. The quantity is too small to be worth its extraction for the arts.—M. de S. believes that it arises from sublimation from lower strata both there and at other places. But in this case it would not be confined to a certain stratum.

Glocker† met with crystals of Arseniuret of Nickel (copper-nickel) sufficiently distinct to be recognized, but not for measurement. Their form is that of a cube, and he concludes that they belong to the rhombohedro-dihexahedric system, and like crystals of peroxide of iron and corundum, that they constitute a transition from the former to the latter.

Sander‡ analyzed a native sulphuret of silver and copper, a silver-copper-glance crystalizing in the form of sulphuret of copper, which occurs at Rudelstadt in Silesia. It consists of:

Silver,	52.71
Copper,	30.95
Iron,	0.24
Sulphur,	15.92
	99.82 = $Cu^2 + Ag\,S$.

Its crystaline form is viewed as one of those circumstances, which apparently prove, that what has hitherto been received as the weight of one atom of silver is properly the weight of two atoms, for it cannot be otherwise explained how it should be isomorphic with sulphuret of copper = $Cu^2\,S$.

Rammelsberg§ analyzed a hyposulfantimonite of iron (Berthierite) from the new mine, Hoffnung Gottest, at Braunberg, near Freiberg. The result was:

Iron,	11.432
Manganese,	2.544
Zinc,	0.737
Antimony,	54.700
Sulphur,	31.326

* An. de Ch. et de Phys. LXV. 286.
† Jour. für pract. Chemie, XII. 182.
‡ Poggend. Annal. XL. 313.
§ Poggend. Annal. XL. 153.

corresponding to the formula—Fe S + Sb^2 S^3, in which a little iron is replaced by manganese and zinc.

*Thaulow** analyzed a basic hyposulfantimonite of lead, (Boulangerite) from Nasafjäll in Lappmark. It closely resembles certain kinds of native sulphuret of antimony, but has a lighter color. It consists of:

Lead,	55.57
Antimony,	24.60
Sulphur,	18.86

corresponding to the formula $(PbS)^3$ Sb^2 S^3, and therefore proportional to ruby silver ore.

The same mineral was described by *Breithaupt*† under the name of Plumbostib, and probably the same as Embrithite. The latter is not fibrous, but massive and fine grained. Both varieties were found in the mine Algatschinski near Nertschinsk.—What a host of ingeniously contrived names some reformer in mineralogy will be obliged to banish at a future period!

Zinken‡ described a mineral from San Antonio, near Copiapo, in Chili, belonging to the same class of sulfantimonites and sulfarsenites. It has a metallic lustre, is colorless, and either tubular, kidney form, or wart form. It contains copper with antimony, arsenic and sulphur.

Jordan§ analysed an arsenical iron pyrites from the mine Felicitas near Andreasberg, which deserves attention on account of its composition. It occurs in quartz in the form of fine white, needle-shaped crystals with a metallic lustre, and yielded in the analysis of a specimen mingled with quartz:

Arsenic,	19.906
Iron,	13.105
Sulphur,	3.078
Silver,	0.004
Quartz,	64.000
	100.183‖

It is distinguished from Mispickel by a less amount of Sulphur. Jordan proposes for it the formula Fe S + Fe^2 As^3.

*Scherer*** examined two Cobalt-minerals from Modum in Norway, which are distinguished from ordinary Cobalt-ore by their crystaline form. One of them is in the form of an Octahedron combined with the cube, dodecahedron and icositetrahedron, has a silver-white color,—a sp. gr. 6.78, and by roasting in a tube before the blow-pipe yields a rose-red powder. It consists of:

Cobalt,	20.01
Iron,	1.51
Arsenic,	77.84
Sulphur,	0.69
Copper,	a trace
	100.05 = Co As^5.

* Poggend. Annal. XLI, 216. † Jour. für pract. Chemie X, 442.
‡ Poggend. Annal. XLI, 659. § Jour. für pract. Chemie X, 436.
‖ There is evidently some error in the figures of the report. Tr.
** Poggend. Annal. XLII, 546.

The other has the form of arsenical iron (rhombic) with a trifling difference in the angles; indeed it is an arsenical iron pyrites in which about one-fourth of the iron is replaced by cobalt, not, however, in a constant ratio, but inversely as the dimensions of the crystals; so that in a very large one, it amounted only to one-fifth. It behaves like arsenical iron before the blowpipe, and after roasting on the glass leaves red peroxide of iron.

*Dove** made some important researches on the unequal influence exercised by quartz in the polarization of light according to its various forms. They resulted in their division into three classes:

1. Those which turn the plane of polarization to the right;
2. To the left; and
3. Those combining the two, and these either,
   - *a*, Turning to the right with places where they act like combined plates, or positive one-axis crystals;
   - *b*, Left turning with similar places;
   - *c*, Amethysts, which on certain parts act like those turning right, on others like those turning left, and on intermediate points like positive one-axis crystals.

Dufresnoy† analysed Diaspore from Siberia and found it composed of:

Alumina,	74.66
Peroxide of Iron,	4.51
Lime and Magnesia,	1.64
Silica,	2.90
Water,	14.58
Loss.	1.71
	100.00

from which he calculates its composition as $A^5\ Aq^3$. He views the silica as accidental, and the oxide of iron as altogether foreign, because it may be extracted by muriatic acid without affecting the mineral. He further analysed an older Diaspore from an unknown locality and found in it:

Alumina,	78.93
Peroxide of iron,	0.52
Lime,	1.98
Silica,	1.39
Water,	15.13
Loss,	2.14
	100.00,‡

for which he gives the same formula. Notwithstanding the formula is supported by the analysis, it can hardly be received as the true one, for it supposes $6\ H^2O + 5\ Al^2\ O^3$, and seems to point out one atom of water as belonging either to the silicate of lime alone or that it is also hygroscopic. In that case it becomes the natural formula of $H^2O + Al^3\ O^3$, as *Hess* proved of the mineral purified by acid (see Annual Report, 1832.)

Tamnau§ examined with accuracy the grounds which induced *Quenstedt* to suppose (An. Report, 1837) that the soap-stone mineral at Snarum in Norway, forming pseudomorphic crystals in serpentine and resembling

* Poggend. Annal. XL, 607.
† Jour. für pract. Chemie XL, 129.
‡ Again a slight error in the figures. Tr.
§ Poggend. Annal. XLII, 462.

Olivine or Chrysolite in form are only decomposed Olivine. He thinks the supposition improbable, and believes that crystals of chrysolite have been removed and the cavities filled with the same substance which constitutes the surrounding formation, viz. Serpentine.

A mineral from Nontron, mentioned in the Ann. Report for 1829 and called Nontronite by Berthier, was found in an iron mine near Andreasberg, and analysed by *Biewend*,* who found its composition to be:

Silica,	41.10
Peroxide of Iron,	37.30
Water,	21.53
	99.96

It is therefore $F S^2 + 2$ Aq, but the too small amount of water as well as a slight excess of oxide of iron, taken in connexion with the frequent greenish color of the mineral, prove that it must contain a corresponding hydrated silicate of protoxide and peroxide of iron.

The same mineral has been found not far from Autun, in France, and analysed by *Jacquetain*†. He found it to consist of:

Silica,	41.31
Peroxide of Iron,	35.69
Alumina,	3.31
Oxide of Copper,	0.90
Oxide of Zinc,	a trace
Lime,	0.19
Water,	18.63
	100.03

He calculates the formula $A S^7 + 7 F S + 11$ Aq., which, theoretically, is highly improbable. The preceding analysis appears to place it beyond a doubt that the mineral is a hydrated silicate of peroxide of iron, which contains a small quantity of some foreign minerals, in both of the French varieties.

COMMITTEE ON MINERALOGY OF THE FRANKLIN INSTITUTE.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on the Annular Eclipse of September, 1838. *By* J. BLICKENSDERFER, Jr., Esq.

To the Committee on Publication:

Gentlemen—I send you for insertion in the Journal of the Franklin Institute, if deemed expedient, an extract from a letter recently received from Mr. J. Blickensderfer, Engineer in the service of the state of Ohio, communicating his observations of the Annular Eclipse of the Sun, of the 18th Sept., 1838, Dover, Tuscarawas county, Ohio, together with those of two of the Pleiades on the evening of the 27th December, of the same year.

Yours, &c.

Philadelphia, Oct. 29, 1839. SEARS C. WALKER.

* Poggend. Annal. XLI, 162. † Annales de Ch. et de Phys. XLVI, 101.

Roscoe, Ohio, October 16, 1839.

To Sears C. Walker,

Dear Sir—Your favor of the 20th ult. has been duly received, together with the High School Observations of the eclipse of 18th September, 1838, and a number of the proceedings of the American Philosophical Society, for all of which please accept my thanks. The information rendered is highly satisfactory, and the offer of interchanging observations gladly accepted.

My observations are few, being unable to make them except when leisure from business permits, and from my inferior instruments and limited means they will not bear comparison in point of accuracy with those made by persons in more favourable circumstances. Still they may possess some additional interest from fixing, at least approximately, the geographical positions of not merely one, but various places; for being engaged in the engineer service of the state, my station is necessarily often changed. My observations of the eclipse of Sept. 18, 1838, were not made here, but in Dover, Tuscarawas county, Ohio. Last year while engaged on the Walhonding Canal, I suffered from a severe attack of sickness, which forced me to quit my station and return to Dover (the residence of my father,) to recover my health, and it was there during my convalescence that they were made. The latitude was determined by observations on the sun and different fixed stars about the time of their meridional passage. Each of these observations consisted of a series of altitudes, generally between 20 and 30 in number, taken nearly equally on each side of the meridian, the corresponding times being noted and thence the reduction calculated and applied as a correction to the mean of the altitudes. The instruments used were a brass sextant of eight inches radius, graduated to 15″ on a silver limb, by Whitbread, London; and a superior, mercurial, artificial horizon with a glass roof. The mean of ten series of such observations give for the latitude of Dover 40° 30′ 52″ N. These were all made on objects south of the zenith, and I regret to state that circumstances would neither permit me to multiply the number, nor take any towards the north, for correcting the errors of the Instrument, if any. I am inclined to believe, however, from my use and examination of the Instrument, that its glasses are good, and the errors of graduation small; we may, therefore, consider the result above as being within a few seconds of the truth.—The 18th was a day in every way favourable for observation, perfectly cloudless except for a short time between the rupture of the ring, and the end of the eclipse. The corrected mean times of the several phases are as follows, as observed at Jacob Blickensderfer's house in Dover.

Beginning,	2h.	39m.	38.82s.
Formation of Ring,	4	00	25.71
Rupture of Ring,	4	6	9.63
End,	5	18	3.64

The telescope used was a twenty inch achromatic, power 20. The error and rate of the clock were determined by eastern and western altitudes of the sun and stars taken on the day of the eclipse and for several days before and after, by the sextant. The clock is not a superior one, yet the rate was uniform to a fraction of a second, and every care was taken to make the observations as good as the instruments would render; and making due allowance for the quality of the Instruments, the observations are good.—On

the 27th Dec., 1838, I observed, at the same place, with the same Instruments, the two following occultations, viz:

η Pleiadum	Im.	7h.	29m.	19.80s.	}	Mean time.
f "	Im.	8	15	3.00	}	

The clock was regulated in the same manner as for the eclipse, and the observations are likewise satisfactory. These are all the observations made in Dover; I have two more made in Roscoe, but as I have not yet determined the latitude, I defer sending them at present. They were on b Pleiadum, Sept. 26th, 1839, and on τ Sagittarii, Oct. 14.

Respectfully,

J. Blickensderfer, Jr.

Practical description of the process called the Daguerreotype, which consists in the spontaneous reproduction of the images of natural objects, in the Camera Obscura; not with their colours, but with great delicacy in the gradation of the tints. By Daguerre.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. F. FRAZER.

Description of the Process. The drawings are made upon thin sheets of silver, plated upon copper. Although the copper serves principally to support the plate of silver, the union of these two metals promotes the perfection of the result. The silver should be as pure as possible; as for the copper, its thickness should be sufficient to maintain the plane of the silver in order that the images may not be deformed, but we must avoid giving it more thickness than is necessary to attain this end, on account of the weight resulting from it. The thickness of the two metals should not exceed that of a stout card.

The process is divided into five operations.

The first consists in polishing and cleaning the plate, so as to render it fit for receiving the sensitive coating.

The second, in applying this coating.

The third, in submitting the plate thus prepared, to the action of the light in a camera obscura, in order to receive upon it the picture from nature.

The fourth, in causing this picture to appear; it not being visible when first taken from the camera obscura.

Finally, the fifth has for its object, the removal of the sensitive coating which would continue to be modified by the light, and would tend necessarily to destroy the impression altogether.

First Operation. This requires a small flask of olive oil; very fine carded cotton; pumice ground exceedingly fine, tied up in a piece of muslin sufficiently thin to suffer the pumice to pass through it easily, when shaken; a bottle of Nitric Acid diluted with water in the proportion of one part (by measure) of acid, to sixteen parts (by measure) of distilled water; a frame of iron wire upon which the plates are put in order to heat them by means of a small spirit-lamp; and finally a small spirit-lamp.

As was before mentioned the drawings are made upon silver-plate. The size of the plate is limited by the size of the apparatus. It must in the first place be well polished. For this purpose, it is sprinkled with pumice (shaking it without touching the plate) and is rubbed gently, in a circular di-

rection, with cotton soaked in a little olive oil. In this operation the plates are laid upon a sheet of paper which must be renewed from time to time.

The pumice is re-sprinkled and the cotton renewed several times. The mortar employed for pulverizing the pumice should be neither of cast-iron nor of copper, but of agate; it should then be levigated upon ground-glass with a glass muller, using very pure water, and should not be employed until perfectly dry. It may be conceived how important it is that the pumice should be so fine as not to scratch, since it is upon the perfect polish of the plate, that the beauty of the picture, in a great measure depends. When the plate is well polished it must be freed from the oil, which is done by sprinkling it with pumice and rubbing it dry with cotton, rubbing always in curves; a good result cannot be obtained by rubbing otherwise. A small plug of cotton is then made, which must be wet with a little acid diluted with water as above mentioned. To accomplish this, the plug is placed in the mouth of the bottle, and the whole turned upside down, pressing lightly upon it, so that the centre only of the plug may be wet with the acid, without being deeply impregnated with it; very little is wanted, and care must be taken to avoid wetting the fingers. The plate is then rubbed with the plug, taking care to spread the acid perfectly over the whole surface of the plate. The cotton is changed, and the plate again rubbed, always in circles, so as to spread completely the film of acid, which should, however, merely touch, as it were, the surface of the plate. It will happen that the acid when applied upon the surface of the plate will separate into globules which can only be destroyed by changing the cotton, and rubbing so as to spread the acid very evenly; for the places where the acid has not taken will cause blurs. The acid is known to be very equally spread, when the surface of the plate is covered with a regular veil over all its extent. The plate is then sprinkled with pumice and rubbed very lightly with fresh cotton.

The plate must then be submitted to a high heat. For this purpose it is placed upon a frame of iron wire, raised to a proper height by legs, the silver above, and the spirit-lamp is passed backwards and forwards along the under surface of the plate, so close that the flame may be broken upon it. After having passed the lamp for at least five minutes under every portion of the plate, a light, whitish coating forms upon the surface of the silver.—The action of the heat is then withdrawn. The heat of the lamp may be replaced by that of a charcoal furnace, which is even preferable, as the operation is sooner finished; in this case, the wire frame is useless, since the plate is laid upon the tongs, the silver above, and moved backwards and forwards over the furnace so as to heat every part equally, until the silver becomes coated with a light, whitish, surface as has been explained. The plate is then quickly chilled by placing it upon a cold surface, such as a marble table. When it is cold it must be again polished, which is quickly done, since it is only necessary to remove the whitish coat which has formed upon the silver. For this purpose the plate is sprinkled with pumice and rubbed dry with a cotton plug; the pumice is frequently resprinkled, taking care to change the cotton often. When the plate is well burnished, it is rubbed, as above mentioned, with the acid diluted with water, sprinkled with a little pumice, and rubbed very lightly with a plug of cotton. The acid must be renewed three times, taking care each time to sprinkle the plate with pumice, and to rub it dry, very lightly, with very clean cotton, taking care that the part of the cotton touched by the finger shall not touch

the plate, since the transpiration would cause blurs upon the drawing. The humid vapour of the breath must also be avoided, as well as drops of saliva.

When it is not intended to operate immediately, the acid is used but twice after the operation of the heat, by which means we may prepare our work before hand, but it is absolutely necessary, when about to commence a drawing, to renew the acid at least once, and to pumice lightly as described above. The pumice dust which is on the surface and edges of the plate is then brushed off with very clean cotton.

Second Operation. For this operation we must have,

The box figured in fig. 1.

A rectangular frame of wood.

Four small metallic strips of the same nature as the plate.

A small hammer and a box of small nails.

A little Iodine.

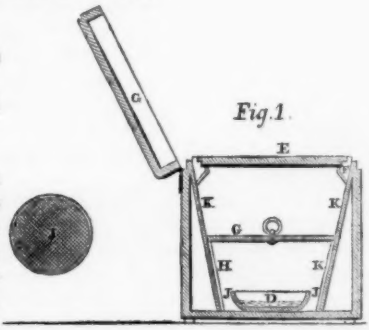


Fig. 1.

After the plate has been fixed upon the frame by means of the metallic strips and small nails which are driven with the hammer designed for that purpose, the iodine must be placed in the capsule which is at the bottom of the box. The iodine must be divided in the capsule in order that the focus of emanation may be larger, otherwise, an iris would form at the centre of the plate which would prevent the obtaining an uniform coating. The wooden frame is then placed, the metal downwards, upon the small brackets fixed at the four angles of the box, and the cover is shut. In this position it must be left until the surface of the silver is covered with a perfect coating of a golden yellow colour. If it be left too long, this golden coating will pass to a violet colour, which must be avoided since the coating is then not so sensitive to the light. If on the other hand the coating be not sufficiently yellow, the image would be produced with great difficulty. So that the yellow must be of a well defined shade, this being the only one which is favorable to the production of the effect. The time necessary for this operation cannot be determined, for it depends upon several circumstances; in the first place upon the temperature of the room, for this operation ought always to be left to itself; that is, it ought to go on without the addition of any heat, other than that which may be added to the temperature of the room in which the operation is performed, provided it be too cold. It is very important in this operation that the temperature of the interior of the box shall be the same as that of the exterior of it; were it otherwise the plate in passing from the cold to the warm air would be covered with a slight coating of moisture very injurious to the results. In the second place, the oftener the box is used the less time is required, because the wood inside of the box absorbs the vapour of the iodine, and this vapour tending always to disengage itself, and rising from all parts of the interior of the box spreads itself much more equally and quickly over the whole surface of the plate, which is an important advantage. On this account it is a good plan always to leave a little iodine in the capsule which is at the bottom of the box, and to preserve the box from humidity. It is thus evident that the box becomes better the longer it it used, for the operation is thus performed in a shorter time. Since, from the causes just mentioned, the time necessary for obtaining the golden yellow coat cannot be

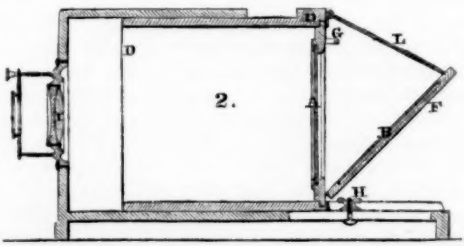
accurately fixed (it may vary from five to thirty minutes, rarely more, unless it be very cold) it may be conceived that it is indispensably necessary to examine the plate from time to time, to see whether it has reached the requisite degree of colour, but it is at the same time important that the light should not strike directly upon it. It sometimes happens that the plate will be more deeply coloured on one side than on the other; in this case, in order to equalize the coating, in replacing the frame upon the box it is turned, not upsidedown, but end for end. The box must be placed in a dark room, into which no light penetrates excepting through the door which is left a little open; and when we wish to examine the plate, after removing the cover of the box, we take the board in both hands, by its ends, and turn it up quickly. It will be enough that the plate reflects a slightly illuminated spot as far off as possible, in order to see whether the yellow tint is sufficiently deep. The plate must then be quickly replaced in the box, if the coating has not attained its proper colour; if, on the contrary, it has gone beyond it, the coating cannot be used, and the first operation must be recommenced from the beginning.

This operation may, in the description, appear difficult, but with a little practice, we are able to judge very nearly the time necessary for the attaining the yellow colour, as also to examine the plate with great quickness so as not to give the light sufficient time to act upon it.

When the plate has attained the proper colour it must be placed in a frame which fits into the camera obscura. The light of day must be prevented from striking upon the plate; for this purpose, therefore, we use a candle, the light of which has much less action; this light must not, however, be suffered to strike too long upon the plate, upon which it will leave marks.

We pass then to the third operation, which is that of the camera obscura. We should pass as quickly as possible from the second operation to the third, or at all events we should not leave more than an hour's interval between them; after this time the compound of iodine and silver has not the same properties.

Observations.—Before using the box it is necessary to clean the interior, and to turn it upside down so as to shake out of it all the small grains of iodine which may have fallen out of the capsule, taking care not to touch the iodine, which would soil the fingers. The capsule should be covered with a piece of gauze stretched upon a ring; this gauze serves to equalize the evaporation of the iodine, and at the same time to prevent the compression of the air, which results from shutting the box, from causing the particles of the iodine to fly about; some of which might rise to the plate and would make deep stains upon it.



On this account the box should always be shut very gently, so as not to cause the rising of any dust within it, which might be charged with the vapour of iodine.

Third Operation. No apparatus is necessary for this operation except the camera obscura, fig. 2. The Third operation is that in which the picture is obtained by means of the camera. Objects illuminated by the sun must be selected, as far as possible, because the operation is under these circumstances much more prompt. It may easily be conceived that as the result is caused by the light alone, the action will be quicker, in proportion as the objects are more strongly illuminated, and are naturally whiter.

After placing the camera obscura opposite to the landscape, or whatever other object, we may desire to copy, the important point is to arrange the focus so that the objects may be defined with great clearness; which is easily done by drawing out, or pushing in, the frame of the ground glass which receives the image. When great precision has been attained, the movable part of the camera obscura is secured by means of the screw adapted for this purpose, and the frame of the glass is then withdrawn, (taking care not to derange the camera) and replaced by the apparatus which contains the plate and which fits exactly into the place of the glass. When this apparatus is properly adjusted, by means of the small copper buttons, the opening of the camera is closed, and the interior doors of the apparatus opened by means of the two semi-circles. The plate is then ready to receive the impression of the view, or object, which has been chosen. Nothing remains but to open the diaphragm of the camera, and count the minutes by the watch.

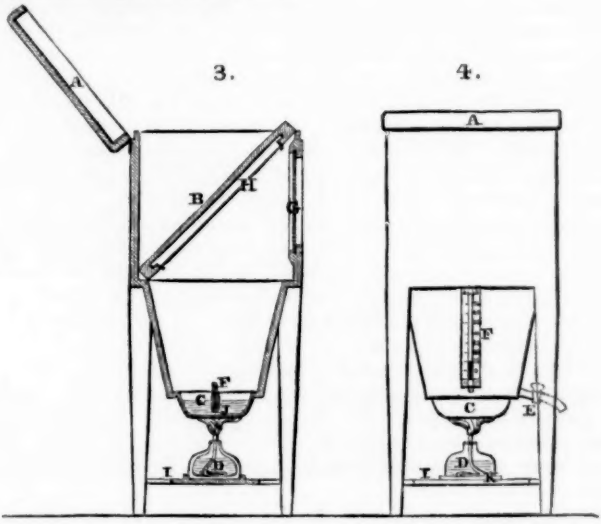
This operation is one of great delicacy, because nothing is visible, and it is utterly impossible to determine the time necessary to produce the effect, since this depends entirely upon the intensity of the light from the objects which we wish to copy; this time may vary, at Paris, from three to thirty minutes.

It must be remarked also that the season of the year, as well as the time of the day, exercises a strong influence on the quickness of this operation. The most favourable time is from 7 until 3 o'clock; and, at Paris, what we obtain in three or four minutes in June or July, will require 5 or 6 minutes in May or August, 7 or 8 in April or September, and so on, in the same proportion as we advance in the season. This is, of course, but a general result for objects strongly lighted, since 20 minutes is oftentimes necessary in the most favorable months, when the objects are entirely of a demi-tint. Wesee, from what has been said, that it is impossible to state with precision the time necessary for obtaining the impressions; but with a little practice, we easily learn to guess at it.—It is evident, that in the south of France, and generally in all countries where the light has a great intensity, as in Spain, Italy, &c. &c., the impressions will be made more quickly. It is also important not to leave the apparatus for a longer time than that necessary for the production of the effect, for the lights will no longer be white, they will be blackened by the prolonged action of the light. If, on the other hand, the time has not been sufficiently great, the impressions will be very vague, and without any detail.

If we have failed in the first impression by withdrawing it too soon, or leaving it too long, we commence another immediately with almost a certainty of success; it is of advantage, even, to make some experimental impressions in order to acquire practice.

The same remarks are now applicable, as upon the termination of the second operation; we must hasten on to subject the plate to the fourth operation as soon as it leaves the camera. Not more than an hour's interval must be allowed, and we are much more certain of success, when we can proceed immediately.

Fourth Operation.—For this we must have,
A bottle of mercury containing at least 2 lbs.
A spirit lamp.
A glass funnel with a long neck.
The apparatus, figured in fig. 3. 4.



Enough mercury is poured, by means of the funnel, into the capsule placed at the bottom of the apparatus, to cover the bulb of the thermometer. This requires very nearly two pounds. From this time we can use no light except that of a candle. The board upon which the plate is fixed, is withdrawn from the frame, (the cover of which, preserves it from the contact of the light,) and slid into the grooves of the black plate (fig. 3.) This black plate is then replaced in the apparatus upon the brackets, which retain it at an angle of 45°, the metal below, so that it can be seen through the glass; the cover of the apparatus is then gently closed, so as to prevent the concussion of the air from causing the particles of mercury to fly about. When every thing is thus arranged, the spirit-lamp is lit, and placed under the capsule containing the mercury, and there left until the thermometer, (the bulb of which is plunged into the mercury—and the tube passes outside of the box) indicates a heat of 140° Fahr. (60° Cent.); the lamp is then quickly withdrawn; if the thermometer has risen rapidly, it will continue to rise without the assistance of the lamp; but we must be careful not to let it rise above 167° Fahr. (75° Cent.)

The impression of the image exists upon the plate but is not visible; it is not for some minutes that it begins to appear, of which we may assure ourselves by looking through the glass, using the light of a candle, and being careful not to let the light strike upon the plate for too long a time, since it would leave its marks upon it. The plate must be left until the thermometer has again descended to 113° Fahr. (45° Cent.); it is then withdrawn and this operation is terminated. When the objects have been strongly illuminated, and the plate has been left rather too long a time in the camera obscura, this operation may be completed before the thermo-

meter has fallen to 130° Fahr. (55° Cent.); we may observe this by looking through the glass.

It is necessary after each operation, to clean the interior of the box carefully, and remove the thin coating of mercury which forms all over it. The black plate must also be cleaned with care, so that no trace of the mercury may be left upon it. When the apparatus is packed for a journey, the mercury in the capsule must be replaced in the bottle, which is done by inclining the box so that it may run out of the small stop-cock placed for that purpose.

The impression may be examined by a feeble light to see whether it has succeeded. It is detached from the board by removing the four small metallic strips which must be carefully cleaned with pumice and a little water, after each impression. It will be seen that this cleaning is necessary, since, not only are these strips covered with a coating of iodide, but they have also received a part of the impression. The plate is placed in a grooved box until it can be made to undergo the fifth and last operation, which need not be performed immediately, for the impression may be preserved in this state, for several months, without undergoing any alteration, provided it be not often examined in a strong light.

Fifth Operation.—The object of this operation is to remove the coating of iodide, which would otherwise, when the impression had been too long exposed to the light, continue to decompose and destroy the picture.

For this operation we must have,

A saturated solution of common salt, or a weak solution of pure hyposulphite of soda.

An inclined plane or frame.

Two tinned copper pans.

A kettle of distilled water.

To remove the coating of iodide, common salt is introduced into a jar, or wide mouthed bottle, until it is one fourth full, it is then filled with pure water. The bottle is from time to time shaken to assist the solution of the salt. When the water is perfectly saturated, that is, when it can dissolve no more salt, it is filtered through unsized paper so that the solution may be free from dirt, and perfectly limpid. This saturated solution of salt is prepared beforehand in sufficient quantity and kept in well corked bottles; by this means we avoid the trouble of making it, at each experiment. The salt water is poured into one of the basins to within about one inch of its edge: the other is filled with ordinary pure water. These two liquids must be heated, but not to boiling. The solution of common salt may be replaced by a solution of pure hyposulphite of soda, this is even preferable, because it removes the iodide entirely, which the solution of salt will not always do, especially when the impressions have been made for some time. In other points, the operation is the same with either solution; that of the hyposulphite need not be heated, and less is needed, since it will be sufficient that the plate be covered by it, when at the bottom of the pan. The plate is first dipped into the pan containing pure water; it is merely dipped and withdrawn immediately, since it suffices that the surface of the plate be covered with water; then, without suffering it to dry, it is plunged into the salt-water. If the plate be not dipped in the pure water before plunging it into the solution of salt or hyposulphite, these will make ineffaceable stains. To facilitate the action of the saline or hyposulphite solution, which takes up the iodine, the plate is agitated by means of a small hook of tinned copper, which is passed

under the plate, which is thus lifted, and suffered to fall again, several times. When the yellow colour has altogether disappeared, the plate is removed, by pressing both hands upon its edges, so that the fingers shall not touch the impression, and plunged immediately into the first pan of pure water.

We then take the inclined frame, and the kettle, which must be very clean, and in which distilled water has been boiled. The plate is taken from the pan of water, and placed at once, upon the inclined plane; then, without giving it time to dry, distilled water, very hot, but not boiling, is poured upon the surface of, and from above, the plate, so that, in descending, the water may form a sheet over its whole surface, and carry with it the whole of the solution of salt or hyposulphite, already much weakened by the immersion of the plate in the first pan.*

At least a quart of distilled water must be used for a plate of ten inches square. After pouring such a quantity of water upon the plate, it is but seldom that one or two drops do not remain upon it. We must then drive them hastily off, before they have time to dry, for they may contain some particles of salt, or, even of iodide; they are removed by blowing strongly with the mouth upon the plate.

It is evidently important, that the water used for washing should be pure; for in drying upon the surface of the plate, notwithstanding the rapidity with which it dries, if this water contained anything in solution it would form numerous and ineffaceable spots.

To test whether the water is fit for this washing, we put a drop upon a burnished plate, and if, when evaporated by means of heat, it leaves no residuum, it may be employed without fear. Distilled water will leave no trace. After the washing, the picture is finished, nothing remains but to preserve it from dust and from vapours which might tarnish the silver. The mercury which causes the image to be visible, is partly decomposed, it adheres to the silver, resists the water poured upon it, but cannot sustain any rubbing.

To preserve the impressions, they must be put under glass and cemented in; they are then unalterable, even in the sun.

As on a journey it may be impossible to attend to the framing of the impressions, they may be equally well preserved in a box with grooves. For greater security, small strips of paper may be pasted over the joints of the cover.†

It must be remarked, that the plates of silver upon copper may be used

* If the hyposulphite solution be used, the water should be less warm than with the common salt.

† The author endeavoured to preserve the impressions by means of different varnishes, obtained from amber, copal, caoutchouc, wax, and several resins; but, he remarked, that by the application of any varnish whatever, the lights in the picture were considerably lessened, and the strength at the same time reduced. To this inconvenience is joined that of the decomposing the mercurial surface by its combination with the varnishes tried. This effect, which was not developed for two or three months, in the end, destroyed the image entirely.

However, it sufficed to induce the author to reject the use of the varnish entirely, that it destroyed the intensity of the lights; since the most desirable improvement upon the process, would be the means to increase them still more.—Author.

According to M. Arago, M. Dumas has found that the plates may be varnished by pouring upon them a boiling solution of one part of dextrine in five parts of water.—Translator.

several times, so long as the copper is not exposed. But it is very important that the mercury should be removed each time, as before explained, by pumice and oil, frequently changing the cotton; otherwise, the mercury will finally adhere to the silver, and the impressions obtained upon this amalgam, are always imperfect, wanting both vigour and cleanness.

Franklin Institute

Sixty-third Quarterly Report of the Managers of the Franklin Institute.

The Board of Managers respectfully present their report for the past quarter.

This quarter, including the summer months, is one of the least active of the year, and its operations are chiefly confined to preparations for the busy season which follows it. The lectures and schools of the Institute have, as usual, occupied much of the attention of the committee having charge of them. The regular lectures on general chemistry, on mechanics and natural philosophy, and on technology, will be again given by Professors Mitchell, Cresson, and Booth, whose services have heretofore been so highly appreciated by the members of the Institute. An arrangement has also been made, by which it is expected that a brief course of lectures on architecture may be added to the regular lectures. The regular course will begin on the fourth of November next. The drawing school will open on the twenty-second instant, with the usual arrangements, as far as the department of miscellaneous drawing is concerned, and under the charge of the former able teacher, Mr. William Mason. It has been deemed advisable, chiefly with a view to prevent interference on the part of our school with that of the Carpenters' Society, to suspend the instruction in the architectural department. It is, however, due to the former teacher, Mr. J. McClure, to state, that previous to coming to this determination, it had been ascertained that his engagements would prevent him from continuing in the charge of the school.

The monthly meetings have been resumed, and the first of the season, which was held on the fourth Thursday of September, was well attended, and supplied with objects of interest. The committee who have charge of the arrangements for their meetings, are active in endeavouring to bring before the members new objects of mechanical or scientific interest.

The committee of science and the arts have, by direction of the managers, reported the number of Scott's legacy premiums awarded under the authority conferred by the City Councils. These are eleven in number, distributed as stated in the report hereto appended. While the committee desire not to hold the premium so high, as not to be attainable by ingenious inventors for whom it was intended by Mr. Scott, they do not feel justified in awarding it without such scrutiny as shall show that the invention for which the award is made, has real merit.

During the past quarter, exhibitions of domestic manufactures have been held at New York, by the Mechanics' Institute, and by the American Institute, and at Boston, by the Massachusetts Charitable Mechanical Association, to all of which delegates have been sent from this Institute. The display of articles at these fairs, has been represented as very creditable to our country, embracing specimens of the useful arts in a high state of

perfection. The impression made by these visits, is calculated to stimulate our own exertions in future exhibitions of the same kind.

Additions of twenty-eight volumes, have been made to the library since the last report, besides pamphlets and periodicals. The cabinets of models and minerals have also been increased by donations.

George W. Smith has become a life member, and fifteen new members have been elected during the quarter.

The Board communicate with regret, the decease of two of their former valued members, Matthew Carey and Rufus Tyler. Mr. Carey was one of the first Vice Presidents of the Institution, and took an active interest in its concerns, when every effort was required to place it in its present favourable position before the public. Mr. Tyler was one of the early members of the institution, and served for many years in the Board of Managers, and upon committees of the Institute, with zeal and ability. His name is connected with the prominent undertakings of the institution since its commencement, and as a contributor to the pages of the Journal, his services also deserve mention. Three years since, Mr. Tyler accepted the situation of chief coiner at the Branch Mint of New Orleans, in which city he fell a victim to the prevailing epidemic in September last, bearing a character for fidelity and ability in the discharge of duty, under trying circumstances, the reward of the zeal and skill which he had already displayed in his new vocation. Respectfully submitted.

(Signed) John Agnew, Chairman.

William Hamilton, Actuary.

Committee on Science and the Arts.

Report of the Committee to the Board of Managers.

The Committee on Science and the Arts, report by direction of the Managers of the Franklin Institute, the number of premiums awarded from the Scott's Legacy Fund, in virtue of the authority delegated to the Franklin Institute, by the City Councils. The following list contains the date of the recommendation of the award, the name of the inventor, and the title of his invention.

1835.	Feb. 12.	Philos B. Tyler, of Philadelphia, for a shifting gauge cock for steam boilers.
	March 12.	Thomas Ewbank, of New York, for tinned lead pipes for conveying water.
	May 14.	McMullin & Hollond, of Sinking Valley, Pa., for a knitting machine.
	"	Amasa Holcomb, of Southwick, Mass., for a mounting for a reflecting telescope.
	Nov. 12.	N. Bassett, of Wilmington, Del., for a compass for detecting local attraction.
	Dec. 10.	W. A. Burt, of Michigan, for an instrument to determine the variation of the compass.
1836.	May 12.	A. Prutzman, of Philadelphia, for a door lock.
1837.	March 9.	Little & Elmer, (formerly of Bridgeton, N. J.,) Philadelphia, for a chronometer.
1838.	Sept. 13.	E. W. Bean, of Philadelphia, for an instrument to determine latitudes.

1839. April 11. Thomas Wood, M. D., of Smithfield, Ohio, for a fountain pen, and for an instrument to find the content of irregular areas.

June 13. T. Ridgway, Jr., of Pottsville, Pa., for an instrument to be used in geological surveys, &c., called a transit theodolite.

Orders have been drawn for the amount of these premiums with two exceptions, not yet claimed by the competitors.

Various circumstances have prevented, up to this time, the execution of a medal to accompany the premiums. The committee hopes that all difficulties will soon be surmounted, and that medals will be prepared to accompany the orders for the amount of the premium.

The committee has taken every pains to give publicity to the fact, that a fund for the award of premiums to those "who make ingenious inventions," is at their disposal, and to invite competition. While they do not hold the award so high as to be beyond the reach of the ingenuity which it was designed to attest, as well as partially to reward, they cannot without degrading their trust, confer this premium, except for really meritorious inventions; for such as present a reasonable degree of ingenuity, and are likely to be successfully applied in practice. They have even appointed a sub-committee to ascertain if among the articles submitted at the last exhibition of the Franklin Institute, there might not be some which, not coming under the designation of articles on the premium list, might still be worthy of reward. This will probably increase the list now presented, but the committee must observe that the number of premiums awarded must depend upon two circumstances; the first upon the merits, and the second on the number of inventions brought before them. Over the first of these points they can have no control; the second they can only influence by giving publicity to their trust, already done, as far as the Journal of the Franklin Institute and the daily press extend, and by not being so fastidious in their selection of inventions as to prevent competition, which they pledge themselves has been their endeavours in past years, and will continue to be so for the future. The very miscellaneous nature of the premiums awarded, will speak conclusively in regard to this latter point.

On behalf of the committee.

A. D. Bache, Chairman.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Dr. Thomas Wood's Instrument for ascertaining the Area of Irregular Plots.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an Instrument for ascertaining the area of irregular plots, invented by Thomas Wood, M. D, of Smithfield, Ohio, Report:

That they have examined the instrument invented by Dr. Thomas Wood, and believe it to be novel and ingenious, and very simple in its construction. It consists of two plates of plain ground glass with their inner surfaces fixed in a frame, so as to be parallel to each other, and only

so far distant as to permit a piece of drawing paper to slide easily between them. They are of a rectangular form, fastened on three sides in any manner which shall leave the surfaces parallel. The fourth side being open, the space within is partly filled with pure quicksilver. By means of a slip of drawing paper, the outer edge of the quicksilver is made straight and rectangular with the sides. Its position is then marked. This may be done by noting on the paper used, its distance from the outer and open edge of the glasses.

The plot of any irregular plot made from field notes or otherwise, is then moved in till the quicksilver extends to that point of the plot which is nearest the outer and open edge. The outer edge being now parallel to the former edge by the manner in which the paper containing the plot is cut, its distance from its former edge is measured or marked on the same paper, and the area of the irregular field is thus found to be the difference of the areas of two given rectangles.

The committee see no reason why such an instrument should not, when constructed with proper care, give results as accurate as those obtained by the common method of plotting, and dividing into right angled triangles by the dividers and plane scale. The area of the rectangle of any irregular plot, when once completed, may thus be formed in five minutes, and all danger of mistake from errors in the entries or in summing up the partial areas is completely obviated.

The committee consider this very useful and ingenious invention worthy of the Scott's Legacy Premium, and respectfully recommend it for the same.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

March 14, 1839.

Report on Mr. L. E. Denison's Corn Sheller.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Corn Sheller, invented by Mr. L. E. Denison, of Sayville, Middlesex county, Connecticut, REPORT:

That the peculiarity of this machine consists in the mode of feeding and retaining the ears of corn in contact with the shelling cylinder. The feeding is effected by surrounding the cylinder with a case termed by the inventor, a *revolving concentric cylindrical rest.*

This case is formed of a number of bars or staves, the ends of which are mortised into the peripheries of two circular heads. The staves are placed at sufficient distance apart to admit an ear of corn between them, and the diameter of the case is such that the stave just clears the pins or teeth of the shelling cylinder within it. The cylinder and its case both revolve on a common centre and in the same direction, the cylinder making about ten revolutions to one of the case. Beneath the case is a series of metal bands surrounding about one half its circumference, and pressed against the stave by spiral springs; this is termed the segment concave; it is divided into sections which are independent of each other, so that

ears of different size may follow in immediate succession without difficulty.

The ears of corn are placed parallel to the axis of the shelling cylinder in a hopper fixed on one side of the machine. As the cylindrical rest revolves, an ear falls into each space between the staves, and is kept in contact with the shelling cylinder, by the pressure of the segment concave; the grain shelled falls beneath the machine, and the cob is delivered at the side opposite to the hopper, after having been in contact with the cylinder during four or five revolutions.

The arrangement of this machine is different from any that has before fallen under the notice of the committee, and although it may seem somewhat complicated at first view, a farther inspection will show that it is as simple in construction as many other analogous machines. Its operation in the presence of some members of the Institute was highly satisfactory; the cobs were thrown out whole and divested of every grain, and the power requisite to keep it in action was less than in many other machines heretofore in use. As this invention appears to be both new and useful, the committee believe it to be a proper object for an award of the Scott legacy premium, and recommend such award under the usual condition.

By order of the Committee.

WILLIAM HAMILTON, Actuary.

October 10, 1839.

COMMITTEE ON PREMIUMS AND EXHIBITIONS.

The report of the judges on Bookbinders' work and Tools—exhibited at the late exhibition of American Manufactures, held by the Franklin Institute, having been pasted by the judges to the invoice, was, by mistake, filed among the invoices, and consequently overlooked. The attention of the committee having been called to the omission by one of the judges, they with pleasure correct the oversight by publishing the following report.

COM. ON PREM. AND EXHIB.

Report of the Judges on Bookbinders' Work and Tools.

The Committee of Judges on Bookbinders' Work and Tools Report that they have examined the articles exhibited as per list No. 32, and offer the following as the result:

No. 412. A case containing 31 Bibles, and 2 vols. of Switzerland—in consequence of the vols. not being accessible to the Committee for examination, they cannot speak as to the particular merits of the workmanship, but state that they exhibit a very considerable degree of taste and judgment in the design and execution of the finishing, and they doubt not that the workman, by attention and perseverance, will be enabled to produce work of a highly creditable character.

No. 523. A case containing 9 books, among which are a vol. of blank paper bound for the purpose of procuring signatures to the Indian Biography; and a copy of the Waldenses—both of which are done in a most splendid super extra fancy style, displaying a degree of taste in design, and judgment in execution, very rarely combined—also a copy of *Byron*, bound in Morocco super extra with a flexible back, deservedly of a most praiseworthy character, alike in regard to solidity, strength and beauty. There is also in same case vols. of "the Gift," Girls' and Boys' Scrap Books, and a

Bible in 2 vols., which are done in embossed (arabesque) binding; and for beauty of workmanship the committee have never seen them excelled, if equalled. The committee would add in regard to the books exhibited in this case, that it is known to them that they *were not got up* for this or any other public exhibition, but were done in the ordinary business course.

No. 597. A case containing 21 books, one, a copy of "the Gift" for 1839, bound in the most superior splendid super extra fancy calf binding, of the most faultless execution and which, in the view of the committee, cannot be excelled.—Also a copy of Aiken's British Poets, bound in splendid super extra morocco binding; this book also displays the same striking superior excellence. The committee add in regard to the two books in this case, that they certainly display the most superior workmanship of any that have been submitted to their consideration, and congratulate the workman upon his great proficiency, the result of no ordinary talent accompanied by industry and perseverance.

No. 478. A case containing Bookbinders' Dies, Stamps, Scrolls and Rolls. To particularize any one piece of workmanship where all excel, would be worse than useless. These articles deservedly reflect the highest credit upon the manufacturers, and regarding them either separately or as a whole, the committee pronounce them the most superior they have ever seen, unequalled.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER, 1838, *With Remarks and Exemplifications by the Editor.*

1. For making *Sulphate, Carbonate, and other Pigments, of Lead;* Homer Holland, Westfield, Hampden county, Massachusetts, November 3.

This patent is taken for "improvements in the process for compounding, making, and producing pulpy compounds, from metallic lead, and the converting of said pulpy lead into sulphate and carbonate of lead for white pigments; and also for making of said pulpy leads into chromate of lead, known as chromic yellow." The special improvements are said to consist in using any alkaline salt in the *moistening solution*, described in the patent to Mr. Holland, of March 18th, 1836. In employing the pulpy compound produced, as described in said patent, for acetate and nitrate of lead, or with the catalytic additions with neutral chromate of potash or soda, or by dissolving the alkaline chromates in water, and using this chromic solution for the moistening of the charge and chamber.

The claims are in accordance with the foregoing statements; but for the proper understanding of them the two specifications must be before the reader, and we will, at an early day, procure copies of them.

2. For an improved *Atmospheric Soda Water Fountain;* Lansing B. Swan, Rochester, Monroe county, New York, November 3.

An air vessel, or receiver, like the common soda water fountain, is prepared, and placed in a vessel containing ice, to serve as a refrigerator. Into this air vessel is to be forced, by means of a suitable pump, an alkaline solution, made by dissolving an ounce of super-carbonate of soda in every gal-

lon of water. The forcing in of this solution will condense the atmospheric air within the receiver, and cause the solution to flow out when required. Any of the usual varieties of sirop are to be used, with the addition of seven ounces of tartaric acid dissolved in every gallon thereof. About an ounce of this is to be poured into a three-quarter pint tumbler, and the alkaline solution then drawn into it.

The claim is to "the placing of a carbonated alkaline solution in a suitable vessel for containing the same, and causing it to pass, as wanted, into a receiver, or air vessel, by means of a force pump, thereby condensing the atmospheric air contained therein, and thus causing it to operate like the common soda water fountain."

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3. For a machine for *Separating Garlic, &c., from Wheat;* Z. Duval, A. Callegan, and J. W. Miller, city of Baltimore, November 3.

The grain is to be rubbed within the space between a solid revolving cylinder, set with teeth, and a hollow cylinder similarly furnished. The main object in view is to effect the rubbing under pressure, and for this purpose the grain is to be fed in through a hopper of considerable height; and the openings for the delivery of it when rubbed, are to be reduced in size and number at pleasure. The grain is led on by placing the teeth spirally. The claim is to "the manner of increasing the pressure upon the grain, by regulating the feeding, and the escape of the same, upon the principle, or in the manner, set forth."

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4. For an improved *Curry Comb;* Nathaniel C. Sandford, Meriden, New Haven county, Connecticut, November 3.

This curry comb is made by affixing several wooden combs upon a plate of iron, or upon wood; and the claim is to "the combination of the wooden comb with the other parts so as to make the curry comb, as described."

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5. For a *Stopper for Chain Cables;* M. P. Mix, Commander in the U. States Navy, Navy Yard, New York, November 3.

The claim is to "the combination of the slide with the upper plate of the stopper, constructed in the manner described, and operated on by a screw, as herein set forth, so as to stop, or allow a free passage to a chain cable." The machine appears to be well adapted to its object; the chain is to pass between a stationary chock, and a sliding piece, confined between suitable cheeks; the slide is to be operated upon by a strong, three threaded screw, giving full command over the chain cable as it passes through.

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6. For an improvement in *Rail-road Carriages, and Wheels;* Robert Grant, city of Baltimore, November 3.

The patentee says that his improvement "consists in the forming a consecutive self regulating train, by connecting the trucks, or frame of the wheels, directly at their centre; whether these frames contain more than one set of wheels or not." The claim is to the particular manner of connecting the train, as described, and "in the improved wheel, the conical form of the inner periphery, in the manner, and for the purpose, set forth." This improved wheel is a modification of that patented by Mr. Granton on the 22d of July, 1837, and noticed under its proper date. As this latter device is not likely to come into use, it is not deemed necessary to make any further remarks concerning it.

7. For *Springs for Rail-road Cars;* Fowler M. Ray, Cattskill, Green county, New York, November 3.

This spring is to be made of leaves or plates, arranged one under the other in the ordinary way, excepting that the ends of the lower plates are not to come into contact with those next above them, until made to do so by the yielding of the spring. The claim is to "the constructing of springs for rail-road cars, or other carriages, in such a manner as that the shorter leaves shall not be in contact with those above them, excepting when the pressure of the load shall cause them so to do."

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8. For an improvement in the *Open Grate for Burning Coal;* James Attwater, New Haven, Connecticut, November 9.

"The design and purpose of this invention and improvement is to inclose the grate, or rack for coal and its contents so as to compel all the air which passes from the room into the chimney to pass through the coal when required, also to prevent the warm air of the room from being carried off too rapidly," &c.

The grate for coal is placed sufficiently far back to admit of transparent sash doors in front, furnished with plates of mica; converting it, in front, into a close stove. The specification is of great length, describing the parts very minutely; the claims, also, are far from brief, but we think that the actual novelty of the thing is not great, and we apprehend that its utility will not be found such as to bring it into general use. There must, unavoidably, be a great loss of heat by inclosing a grate which is set between jambs, as the radiation into the room from the open fire will be much greater, without the interposition of mica doors; and if not set between jambs, such a grate becomes essentially an ordinary close stove.

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9. For an improvement in the *Pump*; Joseph Evans, Lebanon, Ohio, November 9.

In the pump tree there are to be openings in the sides, to get at the bucket, and these openings are to be closed by plugs, and iron bands, which we think a more than questionable *improvement.* The other alterations proposed, stand, in our opinion, in the same predicament; there is sufficient novelty in this invention upon which to found a claim; but, certainly, if we were about to construct a pump, we should have no desire to interfere with the vested rights of the patentee; and as we do not think that we should do him any good by a more full description, or further remarks, we omit them.

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10. For a *Windlass for weighing Anchors;* John M. O'Brian, Brunswick, Cumberland county, Maine, November 9.

This windlass is to be moved by means of handspikes acting upon ratchets and a ratchet wheel at its ends. The ratchet wheel teeth are so formed as to be acted upon by a round bolt, or pin, making a part of the ratchet, the bolt, or pin, being confined between cheeks, to give it the necessary strength. The fulcrum of the ratchet is made capable of being varied so as to increase or diminish the power of the lever, and the consequent motion, at pleasure. These are the main features of the arrangement, and the principal matters claimed. The specification extends through eight well filled pages, and is, we think, unnecessarily prolix.

11. For an improvement in the *Swinging Bridge*; Abner R. Ring, Parma, Monroe county, New York, November 9.

This bridge is to pass over canals, and is to be opened by the contact of the boat, after the passing of which it is to readjust itself. The bridge is to be in two parts, there being a pier in the middle of the canal to support the inner ends of the two sections. These sections turn on pivots on either side of the canal, there being friction rollers, and a circular ring, or hoop, of iron, bearing upon them to sustain the bridge. The boat in passing comes in contact with friction rollers on the ends of levers, which levers give the first impulse in the opening of the bridge. After the passing of the boat, the bridge is to be closed by the action of a volute spring, aided by a counter weight.

Claim.—"What I claim as my invention is the combination of the lever and springs for giving the first impulse to the opening of the bridge; the mode of preventing the jar when the boat comes in contact with the bridge, and guiding the boat through by means of the springs and rollers; and the mode of closing the bridge by means of the combination of the volute spring and counter weight, as described."

The plan appears to be devised with skill, and in a model the operation will be very promising, but beyond this we want for confidence. The structure must, we think, be very light indeed, which could be made to act in the way proposed. If the experiment has been successful, however, we shall be glad to hear of it, and to give it publicity.

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12. For an improved mode of "*Preparing Fuel, and also Stoves to be used therewith;*" Thomas Joyce, Great Britain, November 12.

This invention made much noise for a time, and was considered as a real improvement by several persons eminent for chemical science, but we believe that the plan has been abandoned, and is to be considered as an utter failure. The proposed fuel consisted of charcoal heated with potash; and the stove was to be without a pipe, the products of combustion all escaping into the room. The carbonic acid was to combine with the potash, and thus to prevent all injurious effect from it. We were never able to see how this could be, but if the overwhelming testimony of actual and continued experience had been against us, our theory would have had no weight, and we should have hailed a new fact, and a valuable improvement.

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13. For an improved *Cooking Stove*; Daniel Tisdale, Canton, Norfolk county, Massachusetts, November 12.

In this stove, which is square, there are three ovens, the lower one covers the whole bottom plate, with the exception of room for two side flues. The upper part is divided from front to back into three compartments, the middle one of which is the fire chamber, and those on each side of it are ovens; the draught from the fire passes down to, and entirely under, the lower ovens. There are, as usual, perforations in the top, for cooking utensils. The claim is to "a stove having a large oven covering the whole of the bottom plate with the exception of the flue spaces, in combination with the fire chamber and two side ovens placed above it, and with the respective flues and their appendages conducting the draught in the manner described."

14. For a *Turning Key for Piano Fortes*; John Cutts Smith, Boston, Massachusetts, November 14.

The handle of this turning key stands out horizontally, and the socket which fits on to the turning pins is furnished with a toothed wheel, or wheels, which are received in the head of the handle. A sliding bolt, urged forward by a spiral spring, is contained within the handle, and engages between the teeth of the toothed wheel, a trigger being used to withdraw said bolt. Instead of this arrangement, double ratchet wheels, with palls, or catches, are sometimes used; the object in both cases being to allow the handle to be moved in either direction without its acting upon the socket.

Claim.—"I shall claim as my invention, the above turning keys, constructed and operating in the manner set forth and described; and I also claim the application of a ratchet or toothed wheel, or wheels, to the top of the shank of the key, by which, in connexion with other suitable machinery applied thereto, the handle may be disengaged at pleasure, with the key, for the purpose of operating the same in the manner above described."

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15. For a *Double Mould Board Plough;* Stephen Gregory, Sawpitts, Westchester county, New York, November 14.

As is the case in the greater number of improvements in ploughs, the present patent is taken for the peculiar mode of connecting the respective parts, whilst the general construction remains unchanged. The claims are to "The application of a double rebate and cheeks on both sides of the head piece, to receive corresponding parts in the fore end of the mould pieces, by which wider or narrower mould pieces may be used on the same standard or head piece;" and to "the mode of applying the dovetailed cross wedge to secure the movable double winged share, as applicable to effect the intended purposes."

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16. For apparatus for *Lifting Ships and other Vessels from the Water;* Thomas Bell, Bell Port, Long Island, New York, November 14.

The platform, or cradle, upon which the vessel is to be raised, is placed within a dock, on each side of which there are "tilting boxes," that are made triangular, and rest upon one of their angles; these boxes are loaded with heavy weights, and are capable of being tilted over from the docks, by means of screws operating upon them, aided by weighted bodies suspended from spars which rise from the boxes like masts. The inner edges of the boxes are connected by rods to the cradle beams.

Claim.—"The manner of constructing, combining, and operating the tilting boxes by the employment of the governing screws, formed and used substantially as set forth; and also, in combination therewith, the weighted bodies suspended from the upper ends of the spars, in the manner, and for the purpose, set forth"

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17. For a machine for *Splitting Leather;* Elias Putnam, Danvers, Essex county, Massachusetts, November 20.

This leather splitting machine, is in its general action so much like some others of the many invented for the same purpose, as not to require any particular description. The claim is to "the application of a knife to the interstice between the two rollers, in such a manner that pieces of

leather may be propelled against the knife by the revolution and pressure of the rollers, and may be thus pressed and slit at the same time."

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18. For a *Mud Machine;* John Hart, Middletown, Middlesex county, Connecticut, November 20.

There are various devices referred to, in the claim by letters and figures, showing by the aid of the drawings, the manner in which the patentee has arranged the lifting chain, and other parts of his machine; but these are not susceptible of clear general description, and the claim alone would not show any thing intelligibly.

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19. For a machine for *Hackling Hemp and Flax;* Foster Demasters, Shelbyville, Shelby county, Kentucky, November 20.

The hackles, in this machine, are fixed to an endless chain, their operation not differing essentially from others previously used; the patentee, however, believes that he has so arranged them as to cause them to act more advantageously than in other machines: these arrangements are made known by the drawings, and the claim is to "the combination of the endless chains of hackles with the lips and stationary teeth in the inclined board, for hackling hemp and flax."

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20. For a *Cotton Gin;* William P. Baker, Boston, Massachusetts, November 20.

This gin is of the roller kind, for long staple cotton; the rollers are to be of steel, and are to have teeth on them, so that they may gear into each other; one of the rollers, however, it is said, may be of cork, or other soft material. There is a revolving vibrating feeder, and some other appurtenances, the description of which we shall omit; the claims are, to the vibrating feeder with teeth on the same; to a system of stationary teeth between which the revolving teeth pass; to a moving comb; and to a mode of adjusting the bands by means of sliding frames, in combination with the parts to which they are attached.

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21. For an improvement in *Piano Fortes;* Edwin Brown, Boston, Massachusetts, November 20.

The object of this invention it is said, "is to effect what is termed the *single string change of the hammers*, without any lateral motion of the hammers, as has usually been the practice heretofore."

"It has been necessary to fit and arrange the hammers very nicely, in order to insure their perfect action when changed from the double to the single string. By my improvement one of the strings of each note is clamped or held, and thus prevented from vibrating when the hammer strikes it; the other being free, will vibrate and produce the sound." The means by which the patentee produces this effect is then pointed out, and the combination of the parts, substantially as described, is claimed; and also the "clamping the strings between cushions, or dampers, situated with regard to each other, and affixed to bars or beams, in the manner described; with the arrangement of the machinery which in connexion with the beams, gives motion to said beams when the pedal is pinned down by the musician."

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22. For improvements in the machine for *Shearing Woolen Cloth;*

Seth Parsons, Hoosick Falls, Rensellaer county, New York, November 25.

By means of his improvements, the patentee states, that he "is enabled to shear broad and narrow cloths, the machine operating upon it in its passage back and forth, both ways, without changing it, from end to end." The machine resembles that patented by Mr. Parsons, in March, 1819, but differs from it in the essential particulars above referred to, namely, in its shearing the cloth in its passage back and forth; and also, in a mode of reversing the motion of the brush so as to brush the nap either way as occasion may require, and to raise and lay the nap with the same brush. The claims we need not quote, as they are to the means described in the specification for attaining the foregoing ends.

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23. For a machine for *Crimping Leather;* George and Major Alger, Greenport, Columbia county, New York, November 25.

To seize and hold the leather, there are double pincers, between which a screw operates, having upon it a wedge, which, as the screw is turned, is forced between the cross jaws of the pincers, and causes them both to close. The claim is to the cross jaws as operated by the wedge and screw, and combined with them in the manner and for the purpose described.

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24. For a machine for *Cutting Straw, Hay, Rags,* &c.; John Boynton, South Coventry, Tolland county, Connecticut, November 25.

There are two revolving cylinders which are geared together by pinions, so as to preserve their relative positions. Knives pass from end to end of each of these cylinders, standing at right angles to them, and so situated as that the knives of one cylinder shall stand in the middle of the spaces between the knives of its fellow, in their revolution, and come as nearly as possible into contact with said cylinders. The straw, &c., to be cut is put into a hopper above the cylinders, and requires no feeding apparatus.

The action of this machine is perfect, cutting the articles placed in the hopper with great rapidity, but still we do not think it destined to continue in use; any hard substance introduced with the articles to be cut, will ruin the knives, and such articles are sure to find their way in.

The claim is to "the method of cutting straw, hay, rags, and other substances, with two sets of knives in two distinct cylinders, which, in the revolution of the cylinders, shall pass by each other, the one coming nearly up to the periphery of the cylinder opposite, in the manner described."

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25. For an improvement in the process of *Tanning;* Thomas Chase, City of New York, November 25.

(See Specification.)

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26. For an improved *Plough;* John Deats, Roxborough, Warren county, New Jersey, November 25.

The claims under this patent are, mainly, to devices employed in adapting the parts of the plough to each other, and confining them in place; and although these devices may be very good, a detail of them would not furnish any valid information, as reference is made to the specification and drawings for their illustration.

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27. For a machine for *Gathering or Pulling Flax and Hemp,* by

animal power; William Britain and John Silvers, New Hope, Hunterdon county, New Jersey, November 25.

The claim under this patent is to "a machine, which, as it is drawn forward, embraces the plants between a revolving drum and bands, by which they are pulled out of the ground and deposited on a suitable platform, as described." The platform which sustains the revolving drum runs upon wheels which bear upon the ground, and the axle of one pair of these wheels is geared, by bevel wheels, to the axis of a drum which revolves horizontally. The plants pass in between this drum and a pointed arm which projects forward; they are there clasped between the drum and bands which extend in part round it, and round guide pulleys, and are thus pulled out of the ground, and carried far enough round the drum to be deposited on the platform, the bands being led off from the drum by the guide pulleys at the required point.

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28. For an improvement in the *Organ*; John Meads, city of Albany, New York, November 25.

We are led to expect a particular description of these improvements, from the patentee, with the requisite engravings. The improvements consist mainly, in the substitution of puppet valves for those ordinarily used; a peculiar arrangement of these valves in relation to the wind chest, and the manner in which the key acts upon the stem of the valve; these are said to be real improvements, but they are not of a nature for mere verbal description.

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29. For an improved *Lamp for Burning Spirits of Turpentine;* Luther Jones, city of New York, November 25.

Claim.—"The invention claimed consists in placing two flat tubes, communicating with the fountain, or turpentine holder, within the inner circle of the fountain, (that being of the usual conical form,) each tube containing a sliding clamp which embraces and holds the wick moving in said tubes, placed under a round, or oval, glass chimney, the bottom of which being closed by a horizontal plate, except an oblong space through the centre for creating a draught, so formed as to admit the clamps sliding up and down by means of wire handles connected to the clamps, thereby regulating the light in an instant; from that of the feeblest taper, to a large and brilliant flame, producing a most powerful light in every direction, increased by drawing down the wick instead of raising it, as described."

What are called clamps, are two pieces of tin plate which embrace the wick between them, allowing it to project a trifling distance below their edges. The wick is about two inches wide in the lamp which we have seen, and when it is desired to diminish the light, the clamps, and consequently the wicks, are drawn down.

So far as experience may serve as a guide, the lamps for burning spirits of turpentine are not likely to supersede those for burning oil; there are serious objections to the use of the former, and amongst them is the inflammability of this fluid, for although far less dangerous than what has been called the spirit gas, it is yet far from a safe article.

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30. For an improved *Lamp;* Joshua S. Beale, Great Britain, November 29.

This lamp is intended for the burning of a variety of articles as a substitute

for oil; the patentee mentions "certain fluids obtained by the distillation and occasionally rectification from coal tar, vegetable tar, animal oil, turpentine, rosin, India rubber, bitumen, mineral naphtha, petroleum, and some other of the oleaginous or resinous substances, by mixing with the vapour of the volatile oils obtained from these substances, either atmospheric air alone, or a mixture of air and inflammable gas, such as coal gas and others."

We do not deem it necessary to attempt to describe the construction of this lamp, as we do not think it one that is adapted to the wants of the United States; and will merely observe, therefore, that it has a reservoir and burner similar to those used in the Argand lamp, and that there is, of course, a tube appended to it for the supply of coal, or other, gas, when such is to be introduced in addition to the combustible material contained in the reservoir.

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31. For an improvement in the *Manufacture of Iron;* George Crane, Great Britain, November 29.

It is very generally known that Mr. Crane has succeeded, at his works in Wales, in the smelting of iron by means of anthracite, in the ordinary furnace, by the aid of the hot blast. It is for this that the above named patent has been granted in the United States, as, from the similarity of the Welsh stone coal, and that of Pennsylvania, it was anticipated that the same mode of treatment must succeed with us; this, however, must necessarily be determined by the test of experiment, as differences, apparently slight, in the constitution of the two articles might make very decided differences in the result. For some time past, the necessary arrangements have been in progress for the settlement of this question in the most unequivocal manner, and it has recently been announced, that after encountering those difficulties which almost uniformly attend such undertakings in their incipient state, the most perfect success has attended the experiment; should this be the actual fact, and we have no reason to doubt it, we shall obtain, and lay before our readers, all the necessary details respecting the progress and results of the undertaking.

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32. For a *Universal Bevel Gear;* John Lewis, Burlington, Chittenden county, Vermont, November 29.

The patentee claims the "Universal Bevel Gear," as the same is described in his specification; a principal illustration of the manner of forming this gear is given in the construction of a drill for dental purposes, in which the point of the drill may be made to act in any desired direction with the main shaft upon which it is fixed.

The principle of action is as follows. Let there be two toothed wheels cut with teeth upon their faces so as to constitute them crown wheels, and let the teeth be continued across their peripheries, so as to constitute them spur wheels also; if they stand with their faces towards each other, and their axes in the same line, their crown teeth will interlock, forming a perfect coupling; and if the two wheels are so fixed in a frame that they may be made to stand at right angles with each other, they will then have their crown teeth engaged so as to operate as bevel gear, as they will also at any intermediate angle. If they are carried still further round, so that they engage as spur wheels, the two axes will be parallel, and if a drill be contained in one shaft, its point will be directed towards the operator who turns the

other shaft. The dental drill, which has been deposited in the office as a model, shows the perfection of the plan, and in the details of its arrangements is a good manifestation of the ingenuity of the inventor.

Specification of a patent for a Suspension Bridge. Granted to STEPHEN H. LONG, *Lieutenant Colonel, in the Engineer Corps of the United States, November, 7th,* 1839.

Be it known, that I, Stephen H. Long, of the United States Engineers, have invented a new and useful method of constructing wooden, or frame, bridges; which I shall describe under the name and designation of the suspension bridge, and of which the following is a true and adequate description, viz:

The suspension bridge is composed of two or more truss frames, together with arch braces, lateral braces, flooring, &c., and is distinguished from other bridges heretofore invented, and now in use, by reason of the following actions in the posts, main braces, and counter braces of its truss frames, *to wit:* the posts act by *thrust* instead of *tension*, and the main and counter braces by *tension* instead of *thrust*, as in other bridges. Of course the relative positions occupied by the main and counter braces in the suspension bridge, are completely the reverse of those occupied by them in common bridges, and the modes of attachment between the several parts of the truss frame, are materially different from those of other truss frames, as will be hereinafter explained. In all other respects the suspension bridge is similar to the bridges and parts of bridges heretofore patented by myself.

The truss frames consist of the same nominal parts respectively, of about the same dimensions according to circumstances, as those described, and in part claimed as new, in my specification of a patent for a wooden, or frame, bridge, for which I make application for a patent simultaneously with this application for a brace bridge; excepting that the posts may be narrower and shorter, and the main braces about two feet longer than those applicable in conformity to the specification just referred to; said braces passing through, and protruding five or six inches beyond the strings both above and below.

The length of the posts of the suspension bridge is such as to occupy the distance in the clear between the upper and lower strings; or rather somewhat short of this distance in order to admit a wedge, or a set of counter wedges, between one end of the post and the contiguous string. The posts are all flush, or in the same plane with the outer string-pieces of each truss frame.

The main braces occupy spaces between the central and outer string pieces, extending several inches above the upper, and an equal distance below the lower string, and are suspended by tree nails passing through them, and the string-pieces at the head of the first set of posts, and attached in a similar manner to the lower string-pieces at the foot of the second set of posts. This mode of suspension and attachment is carried on through the half bridge span, beginning at the abutment or pier, and ending at the centre of the span. At the centre of the span, the main braces are halved or locked together, and treenailed as before between the string-pieces. The spaces for the main braces between the central and side string-pieces of the upper string, at the centre of the span, being unoccupied, may receive timbers of the same transverse dimensions as the main braces, which may also be treenailed to the string, and thus afford substantial attachments for the heads of the posts and counter braces that meet at that point.

The counter braces are treenailed at their heads and feet, between the

main braces, except at the centre of the bridge span, where they are attached in the manner already explained, and at the abutment or piers where they are accommodated with similar attachments in connexion with the lower strings.

Arch braces may be applied in a manner to act as suspension braces, by erecting a gallows at each pier and abutment of sufficient height and strength for this purpose; but the most appropriate mode of applying these parts is that adopted in connexion with the plan heretofore recognized in my patents.

In further explanation of the suspension bridge, reference is respectfully made to the accompanying drawings; which will illustrate more clearly the manner of constructing the suspension bridge and the arrangement of its parts.

Should it be regarded as an object of importance to give to the main braces of the suspension bridge an equable action in all the panels of a bridge, the following rules should be observed and the object in view will be approximately accomplished. Let the extent of the bridge span, between the abutment or pier supports, be 120 feet, and the height of the truss frame, or rather the distance from centre to centre of the strings, be fifteen feet. Now, commencing at either extremity of the span, the first panel should have a distance measured on the strings, from centre to centre of the posts, equal to 5¼ feet, the second panel, a distance of 6¼ feet, the third equal to 7¾ feet, the fourth, 9¾ feet, the fifth, 13 feet, and the sixth, 18 feet, making the aggregate extent of the half span, equal to 60 feet. By this arrangement all the main braces respectively will be subjected to an action nearly equable, and their greatest possible efficiency may be rendered available. The diagrams, hereinafter referred to, will serve to illustrate this arrangement, and guide the builder.

This method of adjustment, by means of which a uniformity of action may be given to all the main braces of a truss-frame, respectively, is also claimed as new and original, not only with respect to the construction of wooden bridges, but also with respect to bridges composed of iron, or partly of iron and partly of wood; which may be constructed of similar parts nominally, though these parts may all differ in shape, dimensions, and manner of attachment to each other, all of which may be varied according to circumstances.

In the accompanying drawings, plate III, fig. 1, A, B, C, D, exhibits a side view of a portion of a truss frame of my suspension bridge, attached to its abutment; and fig. 2, shows a similar side view of a part of the truss frame, on an enlarged scale, for the purposes of exhibiting its construction the more clearly. C, D, is the arch brace, which bears upon the abutment as shown at C, fig. 1; *n*, *n*, *n*, in the same figure, represent gibs and keys, which pass through and firmly connect the respective thicknesses of timber, of which the arch brace connects below the lower string piece. The space between the two thicknesses of timber of which the arch brace consists, is filled in with what may be denominated a splicing piece, the whole being confined together by bolts, gibs and keys, or treenails.

G, G, are the posts which extend vertically, and have their ends bearing against the lower and upper string-pieces, against which they abut. At *d*, *d*, between the upper ends of these posts and the upper string-pieces, there are counter wedges, which when driven in, necessarily cause these posts to act upon the string-pieces by direct thrust, which causes the main and counter braces to act by tension instead of thrust.

The string-pieces consist each of three thicknesses of stuff, as shown in the top view H, fig. 3, plate IV, and the main suspensor braces E, E, fig. 2, occupy the spaces between the central and outer string pieces, as above stated,

and extend several inches above the upper, and below the lower string-pieces; the five thicknesses composing the braces and string-pieces being secured together by treenails passing through them. The first of these braces extends from the head of the first set, to the floor of the second set of posts, and so on to the centre of the bridge, where their direction is reversed. The counter extension braces are shown at F, F, fig. 2, plate III. These consist each of a single piece of stuff, which passes obliquely between the two which constitute the main braces, abutting against the middle timber of the string-pieces, and confined at each of their ends between the main braces and posts, by means of treenails, or other analogous devices.

Fig. 3, plate IV, exhibits a horizontal and vertical section of a portion of one of the strings, and shows the manner of connecting the posts, main, and counter braces with the strings. The shades in the upper part H, of this figure, indicate sections of the posts, main, and counter braces at the upper edge of the lower string, and, by inversion, at the lower edge of the upper string. E, F, and G, designate the same parts as in fig. 2.

In fig. 1, plate V, A, B, C, D, is a vertical diagram, intended to exhibit the relative dimensions of the panels of a truss frame for my suspension bridge, so graduated as that the stress, or action upon the main suspensor braces, may be respectively equal in every part of the frame. *a*, *a*, are the posts, *b*, *b*, the main suspensor braces, and *c*, *c*, the counter suspensor braces. P, P, are the abutments or piers of the bridge. Fig. 2, shows the manner of applying the lateral braces, in order to afford a corresponding action laterally between the string pieces, *a*, *a*, *a*, *a*; it will be seen from an inspection of the figures, that the extent of the panels as measured on the strings, increases as measured from the extremities towards the centre of the span of the bridge.

The straining or trussing of the truss frames is effected by driving the counter wedges above mentioned, which are situated, as shown in the drawing, between the upper end of each post, and the upper string piece, but which may, if preferred, be situated between the lower ends of said posts, and the lower string-pieces.

This operation is calculated to elevate the upper string at the points where the main braces are attached to it, and of course to increase the tension of the main braces of the adjacent panel. Every movement of tension thus produced is counteracted by a corresponding degree of antagonal tension in the counter braces, thence the main and counter braces act by tension instead of thrust, and the posts by thrust instead of tension.

Having thus fully described the manner in which I construct my suspension bridge, I do hereby declare that what I claim as new therein, and desire to secure by letters patent, is the manner in which I have combined the posts, the main braces, and the counter braces, as herein set forth, so that by wedging up the posts between the upper and lower string-pieces by wedges, or counter wedges, the thrust of the posts shall cause the main and counter braces to operate by tension, and thereby to sustain the bridge; the main braces, the counter braces, and the posts being connected with each other, and with the string-pieces in the manner described.

I will here remark that although I have mentioned the strings of my bridge as each composed of three pieces, this number may be increased, if desired; the number of pieces of timber in the respective braces, &c., being made to correspond therewith.

STEPHEN H. LONG.

Specification of a patent for an Improved Bridge, denominated a Brace Bridge: granted to STEPHEN H. LONG, *Lieutenant Colonel, in the Engineer Corps of the United States, November 7th*, 1839.

Be it known, that I, Stephen H. Long, of the United States Engineers, have invented certain Improvements in the construction of wooden or frame bridges, the objects of which are greater simplicity, economy and efficiency in the mode of bridge building, and in the arrangement of the parts of bridges, than have hitherto been attained by any combination of principles, or arrangement of parts heretofore adopted in structures of this nature.

The several parts of the bridge to which said improvements relate, are the strings and their splices, the posts, the main braces, the counter braces, and the arch braces of a truss-frame; and also the manner of trussing or straining the truss-frames.

The several parts above enumerated have the same relation to the bridge, and are intended to impart a similar efficiency in sustaining it, as those designated by the same names in the several patents obtained by me for wooden, or frame bridges, and to which reference may be had. These parts however, in the structure herein described, vary materially in their relative, and especially in the transverse, dimensions of the timber used from those contemplated and described in the patents above cited. Instead of timbers of various sizes, and of nearly a square form, the several parts alluded to are to be uniform, or nearly so in all their transverse dimensions, a tranverse section of each timber of all the parts having the form of a parallelogram, varying from two to four inches, by eight to twelve or fifteen inches, according to the length of the bridge-span, the weight of the load to be sustained upon the bridge, and other circumstances connected with these considerations.

Instead of notches or recesses in the string-pieces and posts, by means of which these parts are locked together, and instead of wedges at the insertions of the posts between the string-pieces, the connexions between the posts and strings are effected by means of gibs and keys passing entirely through the strings transversely thereof, and at the same time resting in notches, prepared for the reception of the gib and key, in the back of the post, or in the side opposite to the points or steps at which the main braces communicate their thrust against the posts; the notches serving to regulate and maintain the relations with respect to distance, between the upper and lower strings, the gibs serving to clamp the string-pieces together; and the keys serving not only to confine the strings to the posts; but also, to impart the requisite trussing to the truss frame, and at the same time to force the counter braces into appropriate action.

Joggles, or pieces of timber about two feet long, three inches thick, and three or four inches wide, are inserted in the spaces between the string pieces, and immediately behind the posts, for the purpose of aiding the gibs and keys in counteracting the thrust of the main braces. The joggles are applied subsequently to the adjustments effected by trussing, being confined at one end by appropriate notches in the posts for their reception, and at the other by treenails passing through them and the string-pieces.

The main braces are connected to the posts by means of notches or steps in the latter, adapted to the reception of tuscums at the ends of the former.

Instead of tuscums and steps as described in the preceding paragraph, steps of cast-iron, with appropriate lugs or braces on opposite sides of each step, adapted to suitable receptacles for the same in the posts and braces, as

represented in the accompanying drawings, may be substituted for the purpose of receiving and resisting the action to which these parts are subjected.

The counter braces occupy the entire distance between the upper and lower strings diagonally of each panel of the truss frame, and are confined between the posts by treenails passing through them and the posts near the strings. They may also be confined to the main braces by treenails passing through them at the intersections of the former with the latter. The counter braces are brought into their appropriate action by straining upon the gibs and keys of the strings, in the manner before explained.

The arch braces rise in three or more pieces from a bench or bolster attached to the abutment or pier, below the bridge; pass through the lower string in two or more pieces within the openings or interstices occasioned by the posts and main braces; enter the first, second, or third panel of the truss frame, counting from each end of the bridge span, and thrust against the furthermost posts of the panel entered; being intercepted by these posts, against which the thrust of the arch braces is communicated in part by means of appropriate notches in the former, and corresponding tuscums in the latter. The action of the arch brace is continued past the posts by similar pieces and connexions within the next panel, and by the aid of a splicing piece situated between the posts, and extending from the counter brace of the panel first entered, to that of the panel beyond, and occupying the space between the side pieces of the arch brace. Thus continued, the arch brace extends to the head of the next main braces, and is connected with them near the upper string by means of corresponding tuscums and notches. In order to render the action of the arch brace more certain and efficient, another splicing piece is inserted, extending from the counter brace last mentioned to the head of the next counter brace, and occupying as before, the space between the cheeks or side pieces of the arch brace. The several parts of the arch brace situated within the truss frame, as also the posts and main braces at the crossings or intersections of the arch braces, are firmly united by treenails passing entirely through the several pieces of which they are composed.

The interior portions of the arch braces, situated beneath the truss frames, are respectively furnished with a series of gibs and keys, which serve not only to confine together the pieces of which they are composed, but also to render the arch braces extensible, or the reverse, as may be found necessary, either to give appropriate action to the arch brace, or to increase or diminish the camber of the bridge.

The splicings of the outside string pieces, are effected by means of wooden splicing pieces with appropriate notches, and corresponding tuscums, or with joggles of iron or wood, situated in appropriate notches prepared for their reception in the splicing piece and string-piece, and may be clamped together by gibs and keys, or by screw bolts passing entirely through the strings. The central string piece may also be spliced in a similar manner, or by means of treenails of wood passing entirely through the strings, no other clampings being required in this case.

The lateral bracing is effected by means of locked lattice work, banded by ribbands on both sides of each truss frame of the bridge, both above and below the lateral braces. The ribbands are confined to the lateral braces by treenails passing entirely through them and the braces, at every intersection of the former with the latter.

The accompanying drawings will serve to illustrate and make known the manner in which I construct the respective parts of my brace bridge, and carry my improvements into operation.

In fig. 1, plate II, A, B, C, D, represents a side view of part of a truss frame; C, D, being the arch brace with its lower end, C, resting on a bench, or bolster on the abutment or pier below the bridge; *n*, *n*, *n*, showing the situation of the gibs and keys, by which the respective thicknesses of timber of which the arch pier consists, are confined together.

In fig. 2, A, B, C, D, is an enlarged view of a part of such a frame, drawn to a scale sufficiently large to exhibit the mode of connecting the respective parts thereof, C, D, is the arch brace, E, E, are the main braces, F, F, the counter braces, and G, G, the posts. The timbers constituting the arch brace are connected at *g*, *g*, with the posts G, by means of tuscums and notches, and with one of the main braces E, by similar means, as shown at *e*. The main braces E, E, are likewise connected with the posts G, G, both above and below, by like means. The posts G, G, extend a few inches above the upper and below the lower strings. These strings consist each of three thicknesses of stuff, as shown at H, fig. 1, plate IV. The posts G, G, and the main braces E, E, are each of them double, and their ends are received into the spaces between the centre and the two outer string pieces. The counter braces F, F, are single, and abut against the centre string pieces both above and below. They are treenailed at each end to the posts G, G, and also to the main braces where they pass between them.

The space between the two piers of timber which constitute the arch brace C, D, I usually fill up by inserting what I denominate splicing timber, and connect the whole together by passing treenails through them.

It has been mentioned above, that *n*, *n*, *n*, in fig. 1, plate II, show the situation of the gibs and keys, by which the respective timbers composing the arch beam are connected together; such gibs and keys are also employed for the same purpose in various other parts of the structure. Thus, for example, they are employed in the mortises through the timbers shown at *c*, *c*, *c*, *c*, fig. 2. The manner of constructing these gibs and keys, and of inserting and fixing them, so as to confine the timbers together, will be manifest upon reference to fig. 5, plate IV, where they are represented on an enlarged scale. They are also shown as passing through the string-pieces in fig. 1, and through the arch braces in fig. 2. Between the string-pieces, and immediately behind, and in contact with the posts, I insert joggles, or blocks of timber represented by *b*, *b*, *b*, fig. 2, plate II, which I fasten in place by treenails. These are for the purpose of sustaining the posts, and preventing their yielding or splitting at the gib notches. The mortises *c*, *c*, *c*, shown on the upper and lower string-pieces in fig. 2, intersect the posts in those parts, and the posts are necessarily notched out to allow the gibs and keys to pass on their sides opposite to the main braces. These notches in the posts serve, as above remarked, to maintain the relative distance between the upper and lower string-pieces; to clamp and confine them together, and to impart the requisite power of trussing to the truss frame.

Fig. 1, plate IV, exhibits different views of a portion of the string-pieces, showing the manner of splicing them, and also the relative positions of the string-pieces, posts, and braces, as they project into, and are connected with, each other. These representations apply equally to the upper and lower portions of the truss frame.

Fig. 2, represents a portion of the arch brace, with the manner of applying the gibs and keys thereto, by which it may be extended or contracted at pleasure, the several mortises for the gibs and keys being at equal distances from each other. By this arrangement, the camber of the truss frames may be increased or diminished as may be required. The centre and the two

outer pieces of the five thicknesses represented as clamped together in fig. 4, are those which rest upon the bench or bolster of the abutment or pier, the other two pieces are those which pass up into the truss frame.

Instead of the notches and tuscums formed in the timber for connecting the main braces and the posts, I sometimes employ steps or bearings of cast iron, which are furnished with lugs or tuscums, projecting out from each of their sides, and entering corresponding notches made in the posts and braces. These are shown in place at *a*, *a*, fig. 2, plate II, and separately on an enlarged scale at fig. 4, plate V; similar steps or pieces of cast iron may be employed for splicing and uniting the string-pieces, being substituted for the intermediate notched splicing-pieces of wood represented as used at H, H, fig. 1.

Having thus fully described the manner in which I construct my brace bridge, and connect the respective parts thereof together, what I claim as new therein, and desire to secure by letters patent, are the following, that is to say:

1st. I claim the forming of the truss frames of bridges by connecting and combining string-pieces, posts, main and counter braces, and arch braces, by the aid of gibs and keys constructed as set forth, using therewith such bolts or treenails as I may deem proper, but not intending to claim the use of bolts and treenails as making any part of my invention.

2nd. I claim the employment or use of the gibs and keys formed in the manner set forth, and passing through the string-pieces, and into the posts near their ends, for the purpose of trussing and straining the frame generally.

3rd. I claim the manner of arranging the arch braces, so as to diminish or increase the camber of the truss frames, by the employment of the gibs and keys passing through those portions thereof, which constitute the lower parts of said arch braces.

4th. I claim the construction and employment of a bearing or step of cast iron, furnished with lugs or tuscums, which are let into corresponding notches in the head and foot of the main braces, and the posts, in the manner, and for the purpose set forth.

STEPHEN H. LONG.

Remarks by the Patentee on the Application and Use of the principles embraced in the foregoing Patents.

In the application of the principles contemplated in the preceding patents, and for the purpose of effecting approximately, and with convenience, an equality of action in the main braces of the truss frame, both in the common and suspension bridges, it is deemed advisable to vary the lengths of the panels as measured horizontally on the strings, in the following manner, viz: Let the exterior panel of each bridge span, or the panels nearest the abutments or piers, have respectively an extent of about five feet. Let the panels next in succession, as we proceed from the extremities towards the centre of the span, have respectively an extent of about six feet. Let the third panel from each pier or abutment have an extent of about seven and a half feet; and the fourth, an extent of about nine and a half feet; and let the residue of the panels have a uniform extent of about twelve feet, equal to, or somewhat less than, the distance in the clear between the upper and lower strings of the bridge.

Whenever treenails are inserted, care should be taken to place them in such positions, as will ensure their greatest possible efficiency without im-

pairing the requisite strength and tenacity of the timbers through which they pass.

The treenails should be made of well seasoned, strong and durable timber, and may be formed by driving them through a circular cutter of tempered steel, and of such dimensions as may be deemed most suitable for the particular purposes for which they are intended. The size of the treenails should vary from $1\frac{1}{4}$ inch to $1\frac{3}{4}$ inch in diameter. The more numerous the treenails, the more efficient the structure, provided they are not so frequent as to impair the requisite efficiency of the other bridge timbers.

In the use of the improvements provided for in these patents, it should be borne in mind, that a truss frame may be composed of an indefinite number of string-pieces, posts, main and centre braces, as also of arch-brace timbers, all of which may be uniform in their transverse dimensions and of any size that may be deemed most appropriate, from a thickness of one inch and a width of six inches, to a thickness of four to six inches, and a width of twelve to fifteen inches.

The most convenient method of adjusting the splices of the strings, will probably consist in the insertion of splicing pieces of timber between the string-pieces, through all of which gibs and keys, together with treenails (should the latter be deemed appropriate) may pass, confining the whole firmly together. The requisite tension in the strings at the splices, may be provided for by means of iron joggles, passing vertically in notches prepared in the splicing pieces and string-pieces for their reception. The transverse dimensions of the joggles should be about $\frac{3}{4}$ by $1\frac{1}{2}$ inch, and their length equal to the width of the string pieces. Of course, the notches for the reception of the joggles will be $\frac{3}{4}$ inch deep, and of an equal width; the notches in the splicing pieces, and in the string-pieces being respectively equal, and correspondent to one another.

In the mode of bridge building herein contemplated, there will be very little occasion for screw bolts or other iron work, yet in the confining of the lateral bracing to the truss frames, and in various other parts of the work, screw-bolts, key-bolts, spikes, &c., will greatly facilitate the structure, and may be employed to advantage.

Inasmuch as no gibs and keys are required at or near the centre posts of each span, screw-bolts or key-bolts will be of service for the purpose of clamping together the strings at these points.

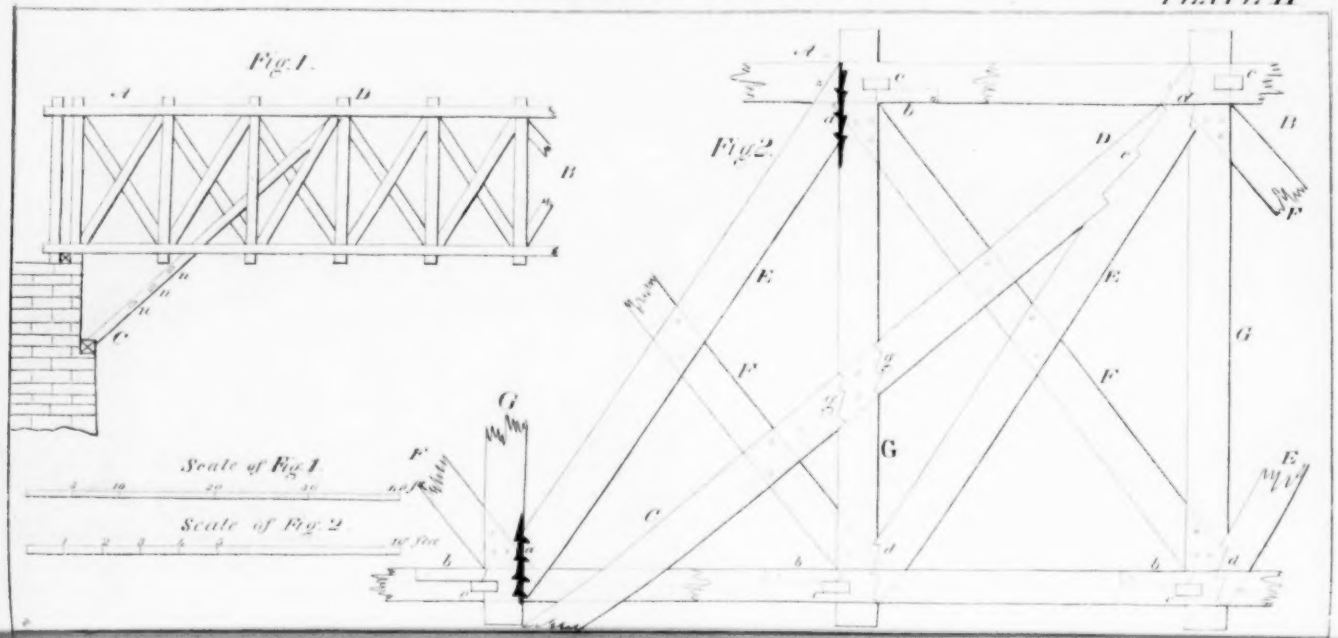
The transverse and stay braces may be applied in the same way as proposed in my former patents.

The adjustments of the arch braces should be such as to insure the greatest possible strength and efficiency. Special care should be taken to introduce the splicing pieces connected with these parts, in a manner to render their action uniformly efficient, quite from the bolster at their lower extremities, to their connexion with the upper strings.

It is obvious that the arrangements prescribed in reference to the suspension bridge, are not only applicable in wooden structures, but, with slight alterations and appropriate modifications, the same principles are equally applicable in the construction of iron bridges. In this application of the principles, it would be advisable to construct all the parts that are exposed to *tension*, of wrought iron, while those exposed to *thrust*, or compression, may be constructed either of wood or of cast iron. The connexion between the strings, main and counter braces, may be effected by means of key-bolts of suitable size, passing entirely through these parts, and confining them togeth-

COL. LONG'S BRIDGE.

PLATE II



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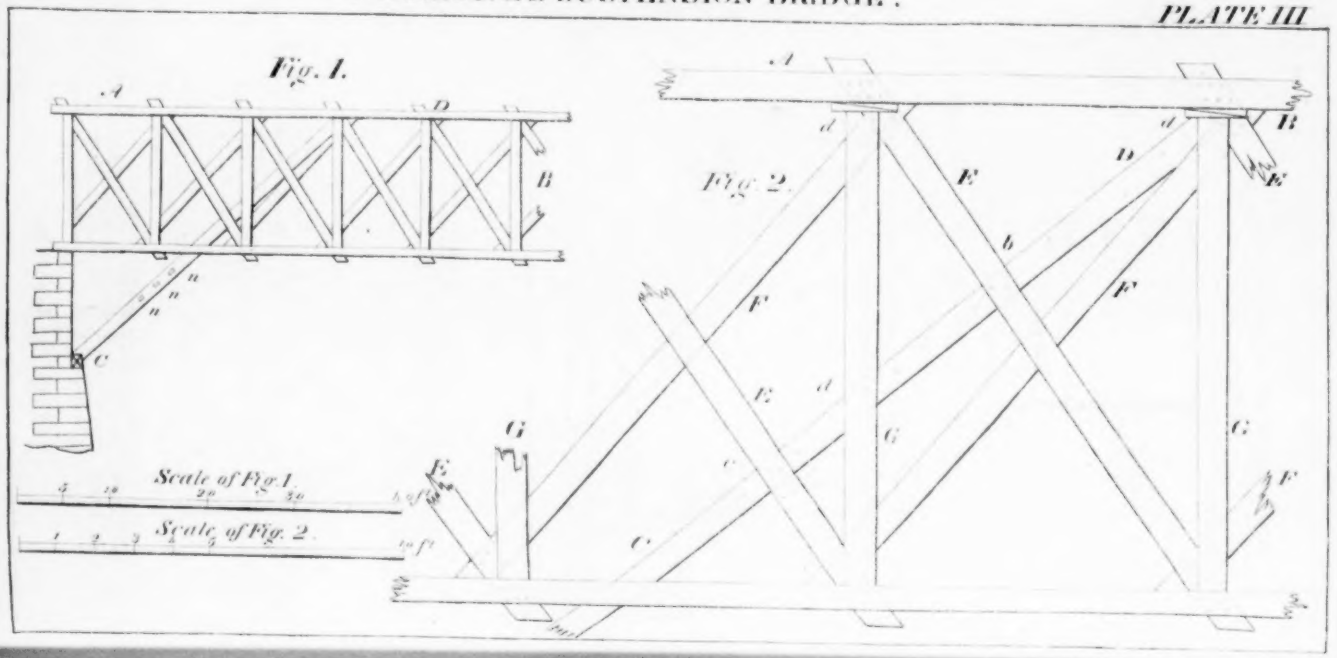
COLLONG'S SUSPENSION BRIDGE.

PLATE III



Parts of Bridge.

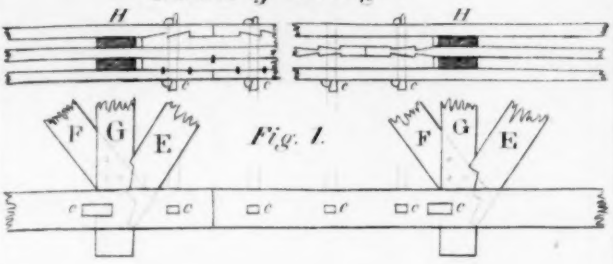


Fig. 1.

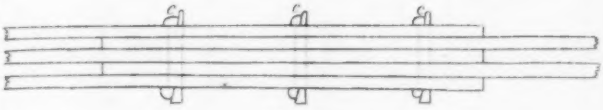
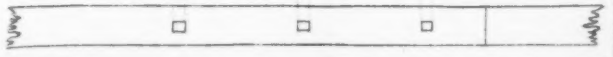


Fig. 2.



Parts of Suspension Bridge

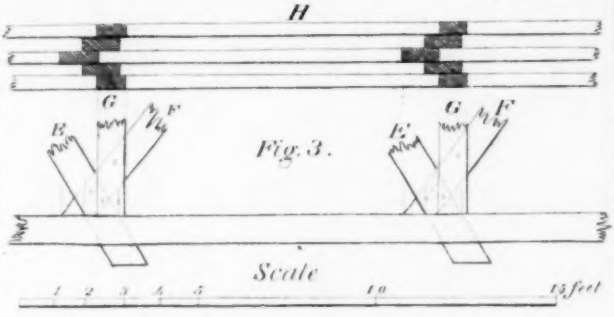


Fig. 3.

Fig. 4.

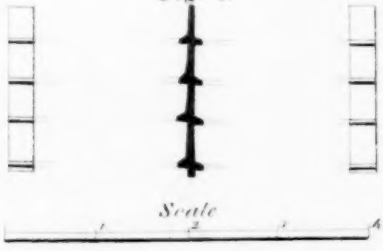
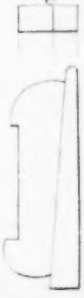
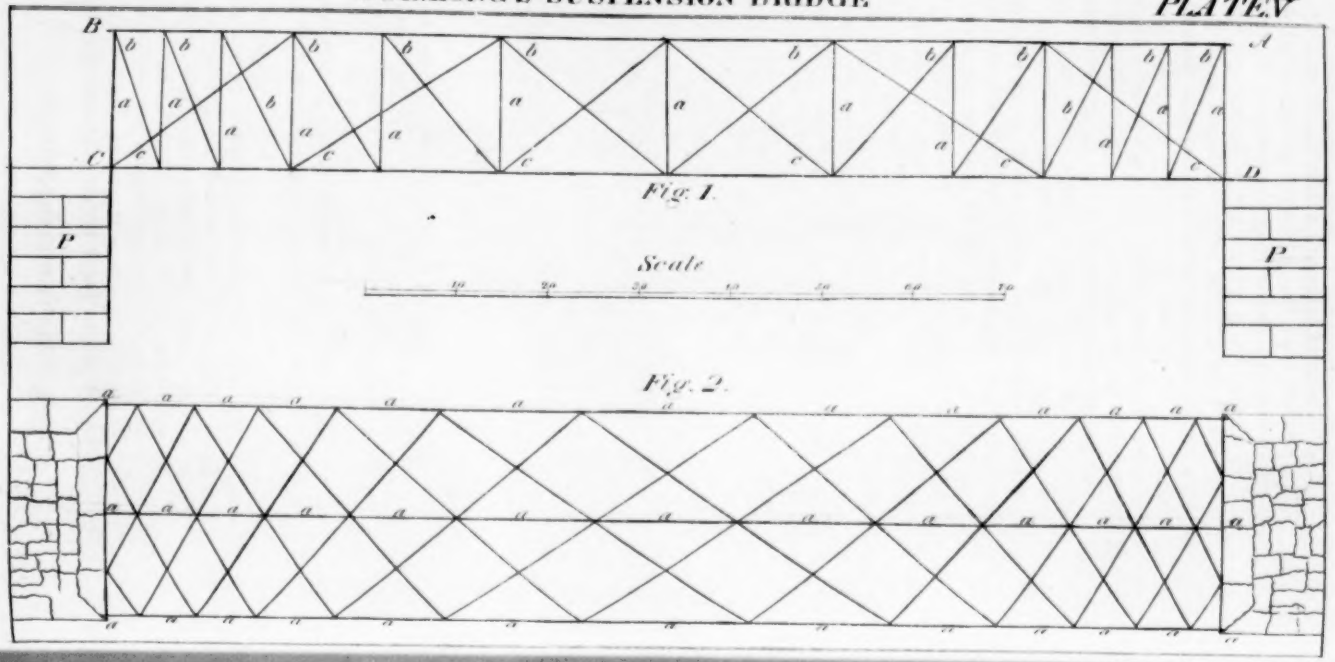


Fig. 5.



COL.LONG'S SUSPENSION BRIDGE

PLATE V



er, the main and counter braces being merely rods or bars of wrought iron with eyes at their extremities, adapted to the reception of the bolts.

It should be farther observed in reference to the suspension bridge, that the heads of the posts should not be confined to the braces till the keys shall have been driven, and the truss frames subjected to their appropriate strain, after which treenails or spikes, at the discretion of the architect, may be inserted through the heads of the posts and braces, and wherever else they may be deemed useful. STEPHEN H. LONG.

P. S. It will be advisable to adopt the following rule for the adjustment of the panels of a bridge span; for example, let the panels situated between any abutment or pier, and the heads of the arch braces, have respectively an extent measured on the strings, about equal to two thirds of the height of the truss-frames from centre to centre of the strings, and let the other panels of the span be adjusted in conformity to the directions prescribed in a former part of this essay. S. H. L.

Specification of a patent for an improvement in the process of Tanning. Granted to THOMAS CHASE, *city of New York, November 25th*, 1838.

To all whom it may concern: Be it known, that I, Thomas Chase, of the city of New York, have invented an improvement in the process of tanning hides and skins, for which process, letters patent of the United States were granted to George H. Richards, of the said city, dated the nineteenth day of December, 1838, by which improvement the process is much simplified, room is economized, and the effect is more certain and rapid, and I do hereby declare that the following is a full and exact description thereof.

Instead of employing two vats, as in the process described by the said George H. Richards, I perform the whole operation in one single air tight vat, which I use in the following manner. I make an air tight vat cistern, or case, of sufficient strength to sustain the pressure of the atmosphere when the air is exhausted therefrom; within this vat or cistern I suspend or lay the hides or skins, in any convenient manner, and completely cover the same with the tanning liquor. The top of the cistern is secured to the body of the vat or box by means of screws, or otherwise, with the intervention of leather or other suitable substance to render the same air tight. By means of an air pump, or other apparatus, affixed on or near the top of the cistern, I exhaust the air therefrom as completely as possible, and after this I work the air pump from time to time, as air will continue to be exhausted from the liquid, and from the pores of the skins, in consequence of the removal of the pressure of the atmosphere from the surface of the liquid. The expansion of the air in, and its extraction from, the pores of the skin opens them, and gives a ready admission to the liquor, or ooze, which in consequence penetrates to the interior of the skin, pervading its whole mass, and tanning it perfectly throughout. I sometimes, after having continued this state of exhaustion for some hours, admit the atmospheric air into the vat, so as to exert its pressure upon the surface of the liquid, allowing it to do so for a short period of time, that it may aid in forcing the liquid into the exhausted pores, after which I again work the air pump and remove the pressure. As occasion may require I renew the liquor in the vat by withdrawing it by a pump, or other means, and returning it to the reservoir of bark or other tanning substance, from which reservoir it is again freshly supplied by a tube, or

other means, to the tanning vat. I also have a barometer, or gauge, connected with the vat, by which to ascertain the degree of atmospheric pressure.

After the tanning liquor has completely penetrated the hides or skins, and become incorporated with them, extra atmospheric or hydraulic pressure, (the latter of which I think the most convenient,) may be applied, in order to give the hides or skins an additional solidity or firmness. I do not prescribe any particular mode of constructing the vats or cisterns, there not being any thing peculiar in these, or in any other part of the apparatus, the whole being such as any competent workman can construct without special directions from me; such apparatus having been before known and used for various purposes, and not being of my invention.

What I claim as constituting my improvement, is the application of the principles of exhaustion to tan vats, after the skins or hides have been laid therein, and they have been covered with the tanning liquor in the manner and for the purpose herein fully set forth. THOMAS CHASE.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the Strength and other Properties of Cast Iron obtained from the Hot and Cold Blast. By WILLIAM FAIRBAIRN, Esq.

The collecting of material for ascertaining the comparative values of iron, made from the hot and cold blast, has been a work of no small labour and expense. The chief difficulties arose from the greater part of the works in this country having only one sort of iron: large quantities of both sorts were obtained; but, excepting those irons experimented upon, none could be found for comparison, nor any on which we could depend for analogous results.

Nearly the whole of the Scotch irons are now prepared by the hot blast; and, with few exceptions, we may consider those of this country and Wales produced under circumstances precisely similar. The great saving effected in the process of smelting by heated air, is in itself a sufficient inducement for its extended application; and in those districts where the iron is not deteriorated, there cannot exist a doubt as to the advantages derivable from its introduction. In confirmation of this opinion, it may be important to know, that one-half or three-fourths of the British ores are now reduced by heated air. In the Staffordshire and Shropshire districts it has become almost universal; and in North and South Wales the old process is rapidly giving way to the more economical application of hot blast. In Yorkshire it has been tried with indifferent success, first at the Low Moor Iron Works, near Bradford, and more recently at the Milton Works, near Sheffield. The proprietors of the former establishment persevered for some time in the use of the hot blast, but after repeated trials and experiments (part of which are briefly detailed in this Report), they abandoned the process, as injurious to the material, and reconstructed the old apparatus for the cold blast.

I believe at the present moment they use air at the temperature of the atmosphere: it is forced from the blowing cylinder into a dry receiver, and from thence into the furnace. Whether the failure which took place at the Low Moor was owing to some peculiarity in the ores, or from the presence of sulphur in the fuel, I am unable to determine. It is, however, obvious,

that a considerable deterioration of strength was the consequence; and from that cause, and that alone, I am informed, the hot blast was discontinued.

At the Milton Works, the heated air is still in use; and although the iron produced is inferior in strength to that made at the neighbouring works, the Elsicar, where the cold blast is used, it is nevertheless much improved by the introduction of a small proportion of the Ulverstone ores, about six per cent., in combination with those found in the district.

Notwithstanding the unfavourable circumstances attending the application of the hot blast in the reduction of the Yorkshire ores, the same results were not obtained in its application to the Scotch iron. In those a deterioration takes place less frequently, as will be seen from the experiments.

Taking a general mean of the experiments in both cases, the difference is not considerable; and, with the exception of the Yorkshire irons, I should consider the results in no way unfavourable to the hot blast: as respects fluidity, appearance, &c., I should rather deem them favourable than otherwise.

Previous to commencing the experiments, it was considered desirable to collect as large an assortment of iron of both kinds as possible; and in order to avoid an improper selection, direct application was made to the iron masters in the first instance, and subsequently the numerous samples were received through the medium of persons whose interests were in no way identified with this inquiry.

In this way we kept clear of preconceived opinions, and collected a mass of material of almost every description. Out of nearly one hundred specimens, only six could be found answering the description of hot and cold blast; viz. the Carron, Devon, Buffery, Coed-Talon, and perhaps the Elsicar and Milton.*

The difficulties thus enumerated, and the scarcity of the comparative metals, have of necessity confined our investigations to the above-named irons, they are consequently more limited than we could wish; but, at the same time, of such a nature as, I trust, will lead to important results.

As an account of the greater portion of the irons collected could not be introduced into these Reports, I was nevertheless induced to examine them minutely; and having tested the whole by careful experiment, the results will be found in a distinct form in the sixth volume of the Manchester Memoirs, now in the press.

After the request of the Association, expressed to Mr. Hodgkinson and myself, that an inquiry should be instituted into the comparative merits of iron made from hot and cold blast, nearly ten months elapsed before the necessary materials could be obtained. In fact, the experiments would have been of the most meagre description, for want of samples, but for the friendly co-operation and assistance of Mr. Murray, of the Monkland Iron Works. To that gentleman we are indebted for the whole of the Scotch irons, exclusive of valuable information relative to the fuel and analysis

* Since the above was written, it was deemed expedient to renew the application to the Carron Company for further supplies of their iron, in order to investigate its nature with increased attention, in addition to the experiments of last year. Mr. Hodgkinson expressed a wish to renew his experiments on the tensile forces of this iron, and also to repeat those with sections of the T form, which were found defective in former experiments. For this purpose a second application was made, through Mr. Murry of Glasgow, to the Company, who immediately furnished the necessary samples. Other sorts, the Muirkirk, the Coed-Talon No. 3, including the Carron No. 3 irons, have been obtained, and their results will be given in the present paper.

of the ores; I have therefore great pleasure in thus publicly expressing my acknowledgments.

Before entering upon the experiments, I made application to the greater part of the works from whence iron was received, for information relative to the nature of the ores, fuel, flux, &c.; also for such analysis as the proprietors might be enabled or disposed to furnish, including the temperature of the air used in the process of smelting.

To these inquiries I received replies which, although of great importance in themselves, could not with propriety be introduced into this report.*

During the progress of the investigation, it was found desirable for Mr. Hodgkinson and myself to divide our labours; and in order to examine the different irons with the utmost care, the experiments were classed and apportioned in the manner described in Mr. Hodgkinson's report.

This division was attended with considerable benefit, as it excited a closer investigation of the subject; and the whole of the experiments being made at my works, gave a facility for comparison that could not otherwise be obtained.

In describing the following experiments, I will first give the tables and results on the transverse or more usually investigated species of strain, where the experiment was made without loss of time, and which may be considered a continuation of the same class of experiments by Mr. Hodgkinson. We shall then proceed to experiments on the Coed-Talon bars, in relation to time or indefinite strain. Afterwards we shall exhibit others on the effects of temperature; and finally close with a general summary of results.

Before presenting the experiments in their tabulated forms, it may be necessary to supply a brief description of each class, in order to show the methods adopted, and how the results were obtained.—For this purpose, a number of models were prepared, to be one inch and one and a half inch square; and the metals, both hot and cold blast, were run into the form of those models. But as there is generally a slight deviation in the size of the casting from that of the model, the dimensions of the bars were accurately measured at the place of fracture, and the results reduced (when practicable) by calculation to what they would have been if cast to the exact size of the model. This was done to ensure more accurate comparisons in the

* Mr. Murray, of the Monkland Iron Work, has, however, supplied me with the following particulars relative to the Scotch irons, viz. the Carron and Devon irons, which are derived, like most of the Scotch metals, from argillaceous carbonate of iron, and are found in the coal-basins of the country. Some of the poorer ores are found in balls imbedded in argillaceous schistus, and worked or turned out with the coal; but the principal is a seam of black band, at a depth of 15 to 25 fathoms under the splint, or fifth seam of coal, of the Lanarkshire basin. This iron stone varies from 9 to 15 inches in thickness, and contains from 35 to 40 per cent. of iron. Two-thirds of this ore is generally used to each charge, and one-third of the poorer balls and bands containing from 20 to 25 per cent.—Dr. Colquhoun analyzed the black band ore, which gave,

Carbonic acid,	.35.17	Peroxide of iron,	0.23
Protoxide of iron,	53.03	Calcareous or bituminous matter,	3.03
Lime,	3.33	Moisture and loss,	1.41
Magnesia,	1.77		100.00
Silica,	1.40		
Alumina,	0.63		

The specific gravity of this ore is 3.0553, colour close brown. The ore contains an intermixture of imbedded bivalve shells.

strength and other mechanical properties of the bars. The mode of reduction is described in the preceding report.

In addition to the methods herein adopted to determine the strength, tenacity, and value of the different irons made from hot and cold blast, I conceived it necessary to institute a series of microscopic observations; to examine with great minuteness the appearance of the fracture, and by magnifying the crystals, to elucidate such visible indications of the fluidity, strength, and ductility of the irons, as would distinguish the qualities of the different numbers known in commerce by the name of No. 1, 2, and 3 iron.

I also pursued in other respects a close and minute examination of the different specimens of hot and cold blast iron, and by turning, filing, grinding, &c., endeavoured to discover their properties in relation to each other, and their adaptation to the arts.

As the Carron No. 2 irons, hot and cold blast, were among the first we obtained, I have, in the description of the fractures attached to each table of experiments, made the Carron No. 2 cold blast iron the basis of comparison. It may therefore be proper to give here the following short description of it.

This iron, when viewed with a microscope, presents a dull gray colour, finely granulated, with an appearance of greater porosity in the centre than round the extreme edges of the fracture. It is a free-working iron, easily cut with the turning tool, but indicates stiffness under the file.

TABLE I.—North Wales Iron.—Coed-Talon No. 2 Pig-Iron, Cold Blast.

Experiment 1. Depth of bar, 1.042 Breadth of do. 1.021 Distance between supports, 4 ft. 6 in. Weight of bar, 5 ft. long, 16¼ lbs.			Experiment 2. Depth of bar, 1.061 Breadth of do. 1.018 Distance between supports, 4 ft. 6 in. Weight of bar, 5 ft. long, 16 lbs. 2 oz.			Experiment 3. Depth of bar, 1.04 Breadth of do. 1.02 Distance between supports, 4 ft. 6 in Weight of bar, 5 ft. long, 15 lbs. 9 oz.			Experiment 4. Depth of bar, 1.076 Breadth of do. 1.04 Distance between supports, 2 ft. 3 in.			Experiment 5. Depth of bar, 1.062 Breadth of do. 1.009 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.
28	.057	..	28	.06	..	28	.072	..	112	.028	..	112	.030	..
56	.115	+	56	.122	+	56	.125	+	224	.060	..	224	.064	+
126	.299	.015	126	.297	.018	112	.269	.011	336	.092	+	336	.096	.005
154	.37	.023	154	.37	.027	168	.420	.024	448	.125	.006	448	.154	.007
182	.451	.032	182	.452	.035	224	.584	.042	560	.162	.008	560	.172	.010
238	.615	.06	238	.618	.059	280	.748	.064	672	.203	.010	672	.215	.014
294	.8	.08	294	.797	.083	336	.924	.085	784	.242	.016	784	.258	.020
350	.993	.115	350	.989	.114	392	1.105	.123	896	.290	.025	896	.308	.028
406	1.21	.162	406	1.202	.16	448	1.315	.185	952	.316		952	broke	
434	1.332	.195	434	1.32	.19	462	broke		1008	broke				
448	broke		448	1.386										
			462	broke										
∴ Ultimate deflection = 1.391. Broke 1¼ inch from the centre.			∴ Ultimate deflection = 1.452. Broke at the centre.			∴ Ultimate deflection = 1.364. Broke ¼ an inch from the centre.			∴ Ultimate deflection = .341. Broke 1 3-8 inch from the centre.			∴ Ultimate deflection = .332. Broke ¼ an inch from the centre.		

The microscopic appearance of this iron is a deeper gray colour than is exhibited in the Carron No. 2 cold blast; it is also more open than it is in the centre of the bar, with a diminution of the crystals as they approach the exterior skin. It is less ductile than the hot blast, and inferior to it in the power of resisting impact.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection (d).	Product $b \times d$ or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports.	6.951 6.916	14680000	404.2	1.453	587.3
Experiment 2nd, bar 4 ft. 6 in. between supports,	6.916	13947000	403.1	1.540	620.7
Experiment 3rd, bar 4 ft. 6 in. between supports,	7.038	14285000	418.8	1·419	594.2
Mean,	6.955	14304000	408.7	1.470	600.7
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	837.2	.367	307.2
Experiment 5th, bar 2 ft. 3 in. between supports,	..	..	836.6	.353	295.3
Mean,	..	..	836.9	.360	296.2

TABLE II.

North Wales Iron.—Coed-Talon No. 2 Pig-Iron, Hot Blast.

Experiment 1. Depth of bar 1.071 Breadth of do. 1.000 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 15¾ lbs.			Experiment 2. Depth of bar, 1.057 Breadth of do. 1.010 Distance between supports, 4 ft. 6 in. Weight of bar, 5 ft. long, 16 lbs.			Experiment 3. Depth of bar, 1.044 Breadth of do .994 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.065 Breadth of do. 1.002 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.
28	.065	..	28	.071	..	112	.031	..	112	.030	..
56	.130	.005	56	.130	.005	224	.070	..	224	.066	..
126	.325	.025	126	.329	.030	336	.109	+	336	.103	.005
182	.503	.052	182	.507	.056	448	.152	.007	448	.144	.007
238	.700	.085	238	.698	.089	560	.200	.012	560	.188	.011
294	.910	.120	294	.910	.124	672	.251	.020	672	.238	.019
350	1.149	.170	350	1.153	.184	784	.307	.030	784	.290	.028
406	1.420	.245	406	1.435	.265	840	.343		896	.355	.045
434	1.570	.295	462	1.764	.370	896	broke		952	.390	
448	1.654		469	broke					980	broke	
462	broke										
∴ Ultimate deflection =1.738. Broke ¾ of an inch from the centre.			∴ Ultimate deflection =1.808. Broke ½ an inch from the centre.			∴ Ultimate deflection =.375. Broke at the centre.			∴ Ultimate deflection=.407. Broke ⅝ of an inch from the centre.		

In this iron the crystalization is more perfect, when contrasted with the cold blast from the same ore; it presents larger granules than it, accompanied with more lustre over the whole surface of the fracture. It is a free, kindly-working iron; easily cut with the chisel, and files with a sense of adhesion to that instrument.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking Weight (b).	Ultimate deflection (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	6.970 6.956	15810000	402.8	1.861	749.6
Experiment 2nd, bar 4 ft. 6 in. between supports,	6.977	12835000	415.6	1.911	794.2
Mean,	6.968	14322500	409.2	1.882	771.9
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	835.5	.392	327.5
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	862.3	.434	374.2
Mean,	..	..	848.9	.413	350.8

Comparative results of Coed-Talon Iron No. 2.

Distance between supports 4 ft. 6 in. and 2 ft. 3 in.

Strength of Cold Blast Iron.	Strength of Hot Blast Iron.	Ratio of Strengths.
404.2 403.1 Mean 408.7 418.8	402.8 415.6 Mean 409.2	1000 : 1001
837.2 836.6 Mean 836.9	835.5 862.3 Mean 848.9	1000 : 1014
Mean ratio of strength, 1000 : 1007		

Results of products, and ratio to resist impact.

Product of strength by ultimate deflection in Cold Blast Iron.	Product of strength by ultimate deflection in Hot Blast Iron.	Ratio of products, or of power to resist impact.
587.3 620.7 Mean 600.7 594.2	749.6 794.2 Mean 771.9	1000 : 1285
307.2 295.3 Mean 296.2	327.5 374.3 Mean 350.8	1000 : 1184
Mean ratio of powers to sustain impact, 1000 : 1234		

Modulus of elasticity in lbs. for a base of an inch square.

Cold Blast Iron,	14680000	Hot Blast Iron,	15810000
Do. . . .	13947000	Do. . .	12835000
Mean,	14313500	Mean,	14322500

NOTE.—The modulus of elasticity was taken in this, as well as in other cases, from the 4 ft. 6 in. bars, and from the deflection caused by 112 lbs.

TABLE III.—North Wales Iron.—Coed-Talon No. 3 Iron, Cold Blast.

Experiment 1. Depth of bar, .996 Breadth of do. 1.005 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth of bar, 1.035 Breadth of do. 1.017 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth of bar, .996 Breadth of do. 1.015 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.035 Breadth do. 1 017 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.067	..	28	.060	..	112	.030	..	112	.031	..
56	.131	+	56	.117	+	224	.068	..	224	.060	..
112	.257	.010	112	.231	.012	336	.102	+	336	.092	+
168	.400	.018	168	.357	.023	448	.140	+	448	.122	.005
224	.542	.030	224	.491	.036	560	.178	.006	560	.156	.007
280	.695	.047	280	.623	.050	672	.217	.008	672	.189	.009
336	.850	.064	336	.762	.069	784	.256	.012	784	.221	.011
392	1.022	.090	392	.910	.089	896	.300	.020	896	.257	.017
448	1.204	.121	448	1.070	.112	1008	.349	.031	1008	.300	.022
504	1.400	.164	504	1.238	.148	1064	.377	..	1120	.340	.031
532	1.520		560	1.425	.191	1120	.408	.045	1176	broke	
560	broke					1176	.439				
						1204	broke				
∴ Ultimate deflection=1.617. Broke at ⅛ of an inch from the centre.			Broke with the weight, 560 lbs., when put on again.			∴ Ultimate deflection=.453. Broke at the centre.			∴ Ultimate deflection=.359. Broke at the centre.		

On comparing the Coed-Talon No. 2, cold blast, with the No. 3 cold blast iron, it will be found that the strength, and also the power to resist impact, is decidedly in favour of the last iron; in the first instance, the proportions are as 537.8 to 408.7, in the latter, 831.2 to 600.7, being a ratio of nearly 24 per cent. in favour of the No. 3 iron. The colour of this iron is a dull gray, with considerable uniformity in its crystaline texture. It is a stiff iron, rather difficult to cut, and accompanied with a hard sensation under the file.

Results reduced to those of bars 1.000 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection in inches. (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7265 7124	17276800	561.7	1.610	904.3
Experiment 2nd, bar 4 ft. 6 in. between supports,	..	16927200	514.0	1.475	758.1
Mean.	7194	17102000	537.8	1.542	831.2
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	1195.7	.4512	539.5
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	1079.0	.3715	401.0
Mean,	..	..	1137.3	.4113	470.2

TABLE IV.—North Wales Iron.—Coed-Talon No. 3 Iron, Hot Blast.

Experiment 1. Depth of bar, 1.002 Breadth of do. 1.005 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth of bar, 1.011 Breadth of do. 1.002 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth of bar, 1.015 Breadth of do. 1.015 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.017 Breadth do. 1.005 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.078	+	28	.071	..	112	.037	..	112	.035	..
56	.150	.007	56	.143	+	224	.073	..	224	.070	..
112	.296	.012	112	.290	.011	336	.109	+	336	.108	..
168	.458	.022	168	.450	.026	448	.147	.005	448	.146	+
224	.621	.038	224	.611	.041	560	.182	.006	560	.183	.007
280	.793	.054	280	.780	.060	672	.221	.008	672	.220	.009
336	.978	.074	336	.957	.080	784	.260	.011	784	.261	.011
392	1.170	.100	392	1.142	.103	896	.302	.017	896	.304	.018
448	1.380	.134	448	1.340	.138	1008	.349	.022	952	.328	..
476	1.488		476	1.450		1064	.378		1008	.352	.025
504	broke		504	broke		1092	broke		1064	.380	
									1120	broke	
∴ Ultimate deflection = 1.588. Broke ¾ of an inch from the centre.			∴ Ultimate deflection = 1.547. Broke ½ of an inch from the centre.			∴ Ultimate deflection = .390. Broke ¾ of an inch from the centre.			∴ Ultimate deflection=.404. Broke 1 inch from the centre.		

The Coed-Talon No. 3, hot blast, is a much clearer iron, with larger crystals than the cold blast, No. 3. It presents a more varied appearance in its crystaline form, with the usual porosity in the centre of the fracture. The colour is more brilliant than that of the last-mentioned iron. This is in many respects similar to the Carron No. 2, cold blast. It is reduced by the file and chisel with more ease than the iron last examined.

Results reduced to those of bars 1.000 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	6992	14732600	499.5	1.591	794.7
Experiment 2nd, bar 4 ft. 6 in. between supports,	6967 6952	14683200	492.1	1.564	769.7
Mean,	6970	14707900	495.8	1.577	782.2
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	1044.0	.3958	413.2
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	1077.5	.4108	442.7
Mean,	..	..	1060.7	.4033	427.9

Comparative results of Coed-Talon No. 3.

Distance between supports, 4 ft. 6 in. and 2 ft. 3 in.

Strength of Cold Blast Iron.		Strength of Hot Blast Iron.		Ratio of strengths.
561.7 514.0	537.8	499.5 492.1	495.8	1000 : 922
1195.7 1079.0	1137.3	1044.0 1077.5	1060.7	1000 : 932
		Mean ratio of strengths,		1000 : 927

Results of products and ratio to resist impact.

Products of strength by ultimate deflection in Cold Blast Iron.		Products of strength by ultimate deflection in Hot Blast Iron.		Ratio of products, or of power to resist impact.
904.3 758.1	831.2	794.7 769.7	782.2	1000 : 941
539.5 401.0	470.2	413.2 442.7	427.9	1000 : 910
		Mean ratio of powers to sustain impact,		1000 : 925

Modulus of elasticity in lbs. for a base of an inch square.

Cold Blast Iron,	17276800	Hot Blast Iron,	14732600
Ditto,	16927200	Ditto,	14683200
Mean,	17102000	Mean,	14707900

If we carefully examine the different experiments in these and preceding tables, it will appear obvious that the hot blast is in every instance the weaker iron, and whether it is viewed in the long or short specimens, the same marked difference in strength is apparent. It is also clear that the No. 3 hot blast is an iron of greater power than the second quality made by hot blast from the same ore. On contrasting the tables, it will be found that the No. 3 iron exceeds the No. 2 in its power to resist a transverse strain nearly one-fifth, and considerably more in its resisting power to sustain impact, this being in a ratio of 1000 to 766.

I have pointed out the defect of the No. 2 iron, not so much for comparison between the hot and cold blast, as from a desire to show the difference which in general exists between the two qualities. In preparing castings for the purpose of supporting great weights, it will be necessary to have reference to the No. 3 iron, as the best adapted for the purpose; it will be found safer than the richer sorts, and should therefore form a considerable part of the mixtures of these descriptions.

The ratio of difference between the hot and cold blast Coed-Talon No. 3, and the Coed-Talon No. 2, is considerable. In the No. 2 we have the hot Blast in the transverse strain a mere fraction stronger, and its power to sustain impact as 1000 to 1234. On the other hand, the No. 3 cold blast stands prominently forward in the ratio of 1000 to 927 for the transverse strength, and 1000 to 925 for the resistance to impact. I offer no opinion as to the cause of these discrepancies; they are correctly given in the experiments, and I must leave the reader to draw his own conclusions.

TABLE V.—English Iron.—Elsicar No. 1 Pig Iron, Cold Blast.

Experiment 1. Depth of bar, 1.033 Breadth of do. 1 025 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 15½ lbs.			Experiment 2. Depth of bar, 1.042 Breadth of do. 1.030 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 15¾ lbs.			Experiment 3. Depth of bar, 1.023 Breadth of do. 1.006 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.016 Breadth of do. .990 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
56	.151	..	56	.129	..	112	.030	..	112	.032	..
112	.291	.030	112	.260	.010	224	.062	..	224	.066	+
168	.444	.048	168	.410	.029	336	.095	+	336	.101	.005
224	.611	.064	224	.571	.044	448	.132	.005	448	.141	.007
280	.782	.087	280	.740	.063	560	.170	.008	560	.181	.010
336	.979	.114	336	.918	.090	672	.215	.011	672	.229	.018
392	1.185	.148	392	1.112	.122	784	.260	.017	784	.276	.022
448	1.390	.190	448	1.320	.161	896	.310	.025	896	.330	.030
476	broke		476	broke		952	broke		952	.355	
									1008	broke	
∴ Ultimate deflection = 1.496. Broke 1 in. from the centre.			∴ Ultimate deflection = 1.424. Broke at the centre.			∴ Ultimate deflection = .334. Broke ¾ of an inch from the centre.			∴ Ultimate deflection = .381. Broke ⅛ of an inch from the centre.		

It must be observed that the Elsicar is entirely cold blast iron, and is here compared with the Milton hot blast. Both irons are from the same ores, and are generally obtained under the same circumstances. In their relative properties there are, however, some slight discrepancies, arising from an admixture of 5 per cent. of Cumberland ironstone, introduced into the Milton iron during the process. The Elsicar is blown from coke, with cold blast, whilst the Milton is produced from 5 parts coal and 1 part coke, with hot blast.

This iron has a vitrified and glutinous appearance over the entire section of the fracture; there is great uniformity,—the crystals being nearly the same in the centre as those next the outer skin of the bar. It has a light gray colour, intermixed with blue. Its working properties are of the first order, the action of filing being accompanied by a soft adhesive sound.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection in inches (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7.056 7.017	13410000	535.2	1.546	672.8
Experiment 2nd, bar 4 ft. 6 in. between supports,	7.017	14552000	425.6	1.484	631.6
Mean,	7.030	13981000	430.4	1.515	652.2
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	904.2	.342	309.2
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	986.3	.387	381.7
Mean,	..	..	945.2	.364	345.4

TABLE VI.—English Irons.—Milton, No. 1 Pig Iron, Hot Blast—Yorkshire.

Experiment 1. Depth of bar, 1.064 Breadth of do. 1.064 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 16 lbs. 9 oz.			Experiment 2. Depth of bar, 1.058 Breadth of do. 1.020 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 16lbs. 8 oz.			Experiment 3. Depth of bar, 1.090 Breadth of do. 1.047 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.067 Breadth do. 1.040 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
42	.103	+	42	.103	+	112	.033	..	112	.033	..
112	.294	.010	112	.298	.006	224	.066	+	224	.070	+
182	.499	.038	182	.518	.033	336	.103	.004	336	.110	.004
238	.685	.065	238	.710	.056	448	.143	.007	448	.153	.006
294	.892	.094	294	.922	.090	560	.186	.009	560	.200	.009
350	1.126	.139	350	1.160	.135	672	.236	.015	672	.250	.016
406	1.382	broke	406	1.430	.209	784	.286	.024	784	.306	.025
			420	broke		896	.350	.038	896	.372	041
						952	broke		924	broke	
Broke $\frac{3}{8}$ of an inch from the centre.			∴ Ultimate deflection =1.492. Broke $1\frac{1}{4}$ inch from the centre.			∴ Ultimate deflection =.379. Broke at the centre.			∴ Ultimate deflection=.388. Broke $\frac{1}{4}$ of an inch from the centre.		

The general appearance of this iron is the usual central porosity of crystalization, which no doubt takes place in consequence of a greater degree of rapidity in the cooling on the outside than within. In the larger descriptions of castings these marks are particularly observable, as the interior mass retains its fluidity for some time after the exterior has assumed the solid form: the phenomena of crystalization are therefore completed under different influences, and hence arises the great and prominent difference which exists in the granulated surface of a large fracture. The working powers of the Milton iron are much akin to the Carron No. 2, cold blast: it possesses less lustre than the Elsicar, but has greater fluidity than appearances would indicate

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch	Breaking weight (b).	Ultimate deflection in inches (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7.016	11701000	337.1	1.471	495 8
Experiment 2nd, bar 4 ft. 6 in. between supports,	6.977				
	6.936	12248000	367.9	1.579	580.9
Mean,	6.976	11974500	352.5	1.525	538.3
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	765 3	.413	516.0
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	780.4	.414	323.0
Mean,	..	..	772.8	.413	319 5

Comparative results of Elsicar Cold Blast Iron, No. 1, and Milton Hot Blast, No. 1.

Distance between supports 4 ft. 6 in.

Elsicar.—Strength of the Cold Blast Iron.		Milton.—Strength of the Hot Blast Iron.		Ratio of the strengths.
435.2	Mean 430.4	337.1	Mean 352.5	1000 : 819
425.6		367.9		
904.2	945.2	765.3	772.8	1000 : 818
986.3		780.4		
Mean ratio of strengths,				1000 : 818

The products, and ratio to resist impact.

Product of strength by ultimate deflection in Cold Blast Iron.		Product of strength by ultimate deflection in Hot Blast Iron.		Ratio of products, or of power to resist impact.
672.8	Mean 652.2	495.8	Mean 538.3	1000 : 825
631.6		580.9		
309.2	345.4	316.0	319.5	1000 : 925
381.7		323.0		
Mean ratio of powers to sustain impact,				1000 : 875

Modulus of elasticity in lbs. for a base of an inch square.

Elsicar Iron (Cold Blast)		13410000	Milton Iron (Hot Blast)		11701000
Do.	do.	14552000	Do.	do.	12248000
	Mean,	13981000		Mean,	11974500

[TO BE CONTINUED.]

On Voltaic Combinations; with some account of the effects of a large Constant Battery; in a letter addressed to M. Faraday, Esq. By J. F. DANIELL, Esq.

The author, pursuing the train of reasoning detailed in his preceding letters, enters into the further investigation of the variable conditions in a voltaic combination on which its efficiency depends: and the determination of the proper proportions of its elements for the economical application of its power to useful purposes. He finds that the action of the battery is by no means proportioned to the surfaces of the conducting hemispheres, but approximates to the simple ratio of their diameters; and hence concludes that the circulating force of both simple and compound voltaic circuits increases with the surface of the conducting plates surrounding the active centres. On these principles he constructed a constant battery consisting of seventy cells in a single series, which gave, between charcoal points, separated to a distance of three-quarters of an inch, a flame of considerable volume, forming a continuous arch, and emitting radiant heat and light of the greatest intensity. The latter, indeed, proved highly injurious to the eyes of the spectators, in which, although they were protected by gray glasses of double thickness, a state of very active inflammation was induced. The whole of the face of the author became scorched and inflamed, as if it had been ex-

posed for many hours to a bright midsummer's sun. The rays, when reflected from an imperfect, parabolic, metallic mirror in a lantern, and collected into a focus by a glass lens, readily burned a hole in a paper at a distance of many feet from their source. The heat was quite intolerable to the hand held near the lantern. Paper steeped in nitrate of silver, and afterwards dried, was speedily turned brown by this light: and when a piece of fine wire-gauze was held before it, the pattern of the latter appeared in white lines, corresponding to the parts which it protected. The phenomenon of the transfer of the charcoal from one electrode to the other, first observed by Dr. Hare, was abundantly apparent; taking place from the *zincode* (or positive pole) to the *platinode* (or negative pole.) The arch of flame between the electrodes was attracted or repelled by the poles of a magnet, according as the one or the other pole was held above or below it; and the repulsion was at times so great as to extinguish the flame. When the flame was drawn from the pole of the magnet itself, included in the circuit, it rotated in a beautiful manner. The heating power of this battery was so great as to fuse, with the utmost readiness, a bar of platinum, one-eighth of an inch square: and the most infusible metals, such as pure rhodium, iridium, titanium, the native alloy of iridium and osmium, and the native ore of platinum, placed in a cavity scooped out of hard carbon, freely melted in considerrable quantities. In conclusion, the author briefly describes the results of some experiments on the evolution of the mixed gases from water in a confined space, and consequently under high pressure; with a view to ascertain, first, in what manner conduction would be carried on, supposing that the tube in which the electrodes were introduced was quite filled with the electrolyte, and there were no space for the accumulation of the gases; secondly, whether, decomposition having been effected, recombination would take place at any given pressure; and lastly, whether any re-action on the current-force of the battery would arise from the additional mechanical force which it would have to overcome. These experiments the author purposes pursuing at some future time. Athenæum.

Improved Method of Case-Hardening Iron.

Sir,—Among the other good qualities which render iron so valuable to the artisan, is the peculiar and important property which this metal possesses of being readily converted, either wholly or in part, into *steel.* The entire conversion of masses of iron into steel by cementation, is a process perfectly well understood and very fully explained in most works treating upon the subject of metals; but the partial conversion of the surface of various articles of iron, after being manufactured, is a process of even greater convenience if not of greater value, and one upon which I beg to offer a few remarks. In this manner various tools and instruments of common use, such as fire-irons, keys, bridle-bits, stirrups, &c. &c., are formed with great facility of soft iron, and by the subsequent conversion of their external surfaces into steel, by the process of *case-hardening*, they combine a toughness and a hardness not otherwise attainable. If formed wholly of hardened steel, brittleness would be their common defect; while if made of iron in its unaltered state the instruments would be altogether too soft for the purpose for which they were intended.

Innumerable articles are therefore continually manufactured from soft iron, which are subsequently coated with steel by an incipient kind of cementation. The method usually adopted has been to place the articles to be

hardened, in an iron box filled with vegetable, or what is better, with animal charcoal; this box, with its contents, being exposed to the action of a strong fire for an hour or two, a partial conversion of the surface of the iron takes place, its depth being proportioned to the duration of the process, the size of the articles, &c. But the time is always incomparably shorter than would be necessary for the entire conversion of the whole mass of the metal. After remaining in the fire the proper time the box is taken out and its contents suddenly thrown into cold water, which effectually hardens the steel coat which has been produced. The articles thus treated are susceptible of a high degree of polish, which forms the finishing process.

This mode of case-hardening has the disadvantage of being inconvenient and tedious, and it has been recently improved by the employment of prussiate of potash (Ferrocyanodide of Potassium.)

Although this valuable discovery is of very recent date, I am unacquainted with its author; the fact is noticed as "*an improvement of great value*" in "Gill's Machinery Improved," and also in "Ure's Dictionary of Arts and Manufactures," both published at the beginning of the present year.

Notwithstanding these publications, this discovery is but little known, and a workman, within my own knowledge, a very short time since, purchased the "art and mystery" of case-hardening with prussiate of potash, as a "*valuable secret.*"

I trust, therefore, in calling the attention of your readers to the subject, I shall be diffusing a more extended knowledge of what I know experimentally to be a highly useful and convenient process.

For this purpose let the crystals of prussiate of potash be reduced to a coarse powder: having your iron articles well cleaned off, heat them at the forge to a bright red, take them out and strew some of the prussiate of potash over them, which will immediately fuse and spread upon the surface, return the article to the fire, and restore the heat, when sudden quenching in cold water will give the required hardness.

By this means, *case-hardening* is more effectually completed in *two minutes* than it could be in *two hours* by the old method; besides which, the workman has the power of case-hardening *part* of any iron instrument, while the remaining portion continues in its original state. This process is also applicable to many articles which could not be conveniently subjected to cementation, and may be applied to cast, as well as wrought, iron goods.

I remain, Sir, yours, respectfully,

Mech. Mag. WM. BADDELEY.

Amalgam for the Rubbers of Electrical Machines.

Fuse a small quantity of zinc either in a crucible or ladle, and pour it gently into about four times its weight of mercury, previously heated in a stone or iron mortar, and stir it well during the time with the warm pestle. Continue to rub the amalgam till quite cool, in order to incorporate the two metals completely; which, if well performed, will give the amalgam a smooth butter-like consistence. It may be made softer, if necessary, by adding mercury during the process. This amalgam, mixed with a very little tallow, is the best we have yet used. Sturgeon's Annals.

Notice or Alarm Gong.

A very ingenious instrument has been invented by Captain George Smith,

R. N., intended to give warning of the approach and to announce the course a steamer is sailing on in a fog. It consists of a gong, on which a hammer is made to strike, every ten seconds, a certain number of blows, by a very simple machinery, according to the course the vessel is sailing on. For example, if she be sailing north, the gong is struck once; if east, twice; if south, thrice; and if west, four times every ten seconds. By this systematic method, the position, course and proximity of a steamer will be clearly announced to any other vessel. In rivers, Captain Smith proposes the vessel to emit single sounds every ten seconds, which would be sufficient to give warning.

Civil Eng. & Arch. Journal.

Progress of Physical Science.

Proceedings of the American Philosophical Society.

September 21, 1838—Mr. Du Ponceau, President, in the Chair.

Solar Eclipse, September, 1838.—The Committee on the solar eclipse of the 18th September, made a report in part, comprising the Observations made at Philadelphia, the principal results of which are as follows:

The observations made at Philadelphia are fifteen in number. A list of observers, telescopes, &c., is given in the following table. The correction in the third column is to be added algebraically to the latitude of the place of observation, to obtain that of the State House, + 39° 56′ 58″. The correction in the fourth column is likewise to be added to the local longitude in time, to obtain that of the State House,—*5h. 0m. 39.2s.*

No.	OBSERVER.	Reduction to Latitude of State House.	Reduction to Longitude of State House.	Focal length in feet.	Makers of Telescope.	Description.	Screen Glass.	Estimated power.
		″	s					
1	E. J. Beans	−70.0	+1.70	2.5	Unknown	Spy-glass	Smok'd	15
2	Wm. Penn Cresson	− 1.8	+5.20	2.5	Jones	Achromatic	Red	30
3	Prof. W. R. Johnson	− 1.8	+5.20	3.5	Dollond	do.	do.	100
4	George M. Justice	−10.0	+2.86	2.5	Jones	Gregorian	do.	80
5	E. O. Kendall	−10.0	+2.86	2.5	Plössl	Dialytic	Green	50
6	Joseph Knox	−21.0	−1.39	3.5	Dollond	Achromatic	Red	80
7	Isaiah Lukens	− 9.0	+0.86	1.8	Plössl	Dialytic	Yellow	20
8	Thomas M'Euen	+ 0.4	+2.33	2.5	Dollond	Achromatic	Red	60
9	Prof. Roswell Park	− 6.5	+1.30	2.5	do.	Gregorian	do.	50
10	Dr. R. M. Patterson	− 1.1	+1.20	5.0	do.	Equatorial	do.	100
11	Wm. H. C. Riggs	+ 0.4	+2.33	3.5	do.	Achromatic	do.	50
12	Samuel Sellers	− 7.5	+0.05	2.5	Jones	do.	do.	40
13	Tobias Wagner	−10.0	+2.86	3.5	Dolland	do.	do.	80
14	Sears C. Walker	−10.0	+2.86	5.0	Tulley	do.	do.	100
15	William Young	+21.0	−1.39	7.0	Holcomb	Herschelian	do.	200

Phases Observed, in Mean Times of the Places of Observation.

No.	A.	B.	C.	D.	F.	H.	I.	K.	L.	M.	N.	O.	P.
	h *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*	*h* *m*
	3 13	4 30	4 31	4 31	4 31	4 35	4 35	4 35	4 35	4 41	5 45	5 45	5 45
1			*s* 3.9			*s* 28.4							
2	*s*		−7.0		*s*	27.8	*s*	*s*			*s*	*s*	
3	10.7		10.5	*s*	15.5	23.5	27.5	29.0			4.2	12.2	
4	7.4		6.3	12.8		27.3						11.3	
5	8.3			10.9		28.4						12.9	
6	12.8												
7				21.7				36.2					
8	•3.0			18.1		29.1						13.2	
9		*s*		19.1		29.1				*s*			*s*
10	7.0	39 1		19.1		30.1				23.1		16.1	19.1
11	7.3	39.2	2.3	16.3		29.4		36.3				7.8	
12	6.0			16.0		31 0						16.0	
13	6.1								*s*				
14	5.6	36.7		15.6	23.0	28.0	29.5	37.0	42.0		10.0	13.0	16.0
15				12.9				38.9				15.0	

• Doubtful.

A. *Beginning.* Prof. Johnson noticed dark indentations for eight seconds after the first disturbance of the limb.

B. Arch of faint light, with speck or brush in centre, round the moon's limb beyond the cusps; brush or blaze in centre, between cusps, extending outwards about two digits. One cusp broken at end, presenting a bright bead.

C. Arch of light much increased in brightness; the brush or blaze, at first in the centre, now extends from cusp to cusp; radiation outwards, nearly three digits; cusps distant 30° on sun's limb, a broken point or bead at each end. This phase noted as that of the formation of the ring by Nos. 1, 2, 3, 4, and 11.

D. *Formation of ring, or instant of osculation of limbs.* This phase noticed as the approach of two sharp well defined points to a contact by Nos. 5 and 15. It was observed at the instant when the cusps, apparently 20° of the sun's limb apart, suddenly united by the extension of four or five luminous beads, or rounded portions of the sun's disc, by Nos. 3, 4, 8, 9, 10, 11, 13, and 14.

E. Omitted in the table. This letter refers to the time when the dark lines, described by Van Swinden and Bailey, should have appeared. They were not seen by any observer, though carefully searched for.

F. Perfect ring, the beads of light having united, or run into each other suddenly.

G. Counterpart of E, not observed though looked for.

H. *Rupture of ring*, counterpart of D. Took place at a point, and so noted by all the observers.

I. Appearance of beads, five or six in number, extending from cusp to cusp.

K. Counterpart of C in every respect.

L. Counterpart of appearance just preceding C. Brush or blaze of light, narrowed down to a small space, 3° or 4° on the moon's border, extending outwards 2½ digits; cusps still broken, as seen by most of the observers. Nos. 5 and 15, however, saw no irregularity of cusps, no beads of light.

M. Final disappearance of arch of faint light, with brush of light extending beyond the middle, having previously become very faint. This phenomenon observed with great care and certainty by No. 10.

N. Appearance of dark lines extending into the sun's disc, noticed by Nos. 3, 4, 10, and 14. The time noted by Nos. 3 and 14 as the end of the eclipse.

O. *End of eclipse*, inferred by each observer from his notes.

P. Final disappearance of the dark lines, the sun's disc having resumed its natural shape. Nos. 3, 4, 10, and 14 inferred the time of O as at some instant intermediate between N and P. The time of external contact difficult to determine, on account of this irregularity.

For the convenience of computers, the local times above given have been reduced to their corresponding value for the State House by E. O. Kendall, by means of his formulæ, in Vol. XX. of the Journal of the Franklin Institute, p. 125, which gives the following values for the variation of the local times of the several phases, for a small variation of terrestrial latitude or longitude, as follows:—

	Beginning.	*Ring.*	*End.*
	s	*s*	*s*
Variation for + or north 1″ terr. lat.	= — 0.0397	— 0.0382	— 0.0343
Do. + or east 1*s* of terr. lon. in time	= +1.2600	+ 1.1400	+ 0.9925

The means of his results for the State House, giving to each observation its proper weight, in mean time of the State House, are,

	h	*m*	*s*
Beginning,	3	13	10.06
Formation of ring,	4	31	18.76
Rupture of ring,	4	35	31.35
End,	5	45	15.46
Duration of eclipse,	2	32	5.40
Duration of ring,		4	12.59

Language of the Valiente Indians.—Mr. Du Ponceau presented a communication, entitled "A Vocabulary of the Language of the Valiente Indians, who inhabit the State of Costa Rica, in Central America, by Col. D. Juan Galindo, of Guatemala." Referred to the Historical and Literary Committee.

New Formulæ, relative to Comets.—Mr. Nulty read a mathematical paper, entitled "New Formulæ relative to Comets, by E. Nulty, of Philadelphia.' Referred to Dr. Patterson, Mr. Walker, and Capt. Talcott.

The subject of this paper was the component velocities of a comet, observed at three consecutive and moderately small intervals of time. In a preliminary notice of his subject and the means employed in its development, the author mentioned some advantages which he conceived to be attached to his peculiar mode of investigation. He alluded to different results already known, and, with several novel and general formulæ comprised in his paper, he announced two new sets of expressions which he represented as being directly applicable to the exceptive cases, in which particular observations render the forms hitherto given, doubtful or indeterminate. He also noticed a numerical application which he made of his formulæ and of others connected with the method of Laplace, to the data of the comet of 1803; and he intimated that a comparison of the results obtained by him in that and other instances, had led him to some remarks, which he inserted towards

the close of his paper, from his opinion of their analytical and practical importance.

Depth of the Sea.—Dr. Patterson read a paper by Professor Charles Bonnycastle, of the University of Virginia, containing "Notes of Experiments, made August 22d to 25th, 1838, with the view of determining the Depth of the Sea by the Echo."

This paper, which was not offered for publication in the Society's Transactions, states that the generally received notions in regard to the intensity of sound in water, and the distance to which it is conveyed, had suggested to Mr. Bonnycastle, some years ago, the idea that an audible echo might be returned from the bottom of the sea, and the depth be thus ascertained from the known velocity of sound in water. The probability of this view was deemed at least sufficient to justify an experiment; and accordingly the Navy Commissioners authorized the construction of the necessary apparatus, and Captain Gedney, of the U. S. Brig Washington, attached to the coast survey, volunteered his services and the use of his vessel, and authority to this effect was liberally granted by the Secretary of the Treasury, Mr. Woodbury.

The apparatus, which is fully described in Mr. Bonnycastle's paper, consisted, first, of a petard or chamber of cast iron, $2\frac{1}{2}$ inches in diameter and $5\frac{1}{4}$ inches long, with suitable arrangements for firing gunpowder in it under water; secondly, of a tin tube, 8 feet long and $1\frac{1}{4}$ inch in diameter, terminated at one end by a conical trumpet-mouth, of which the diameter of the base was 20 inches, and the height of the axis 10 inches; thirdly, of a very sensible instrument for measuring small intervals of time, made by J. Montandon of Washington, and which was capable of indicating the sixtieth part of a second. Besides these, an apparatus for hearing was roughly made on board the vessel, in imitation of that used by Colladon in the Lake of Geneva, and consisted of a stove-pipe, $4\frac{1}{2}$ inches in diameter, closed at one end, and capable of being plunged four feet in the water. The ship's bell was also unhung, and an arrangement made for ringing it under water.

On the 22d of August, the brig left New York, and in the evening the experiments were commenced. In these, Mr. Bonnycastle was assisted by the commander and officers of the vessel, and by Dr. Robert M. Patterson, who had been invited to make one of the party.

In the first experiments, the bell was plunged about a fathom under water and kept ringing, while the operation of the two hearing instruments was tested at the distance of about a quarter of a mile. Both instruments performed less perfectly than was expected; the noise of the waves greatly interfering, in both, with the powers of hearing. In the trumpet-shaped apparatus, the ringing of the metal, from the blow of the waves, was partly guarded against by a wooden casing; but, as it was open at both ends, the oscillation of the water in the tube was found to be a still greater inconvenience, so that the sound of the bell was better heard with the cylindrical tube. At the distance of a quarter of a mile this sound was a sharp tap, about the loudness of that occasioned by striking the back of a penknife against an iron wire: at the distance of a mile the sound was no longer audible.

In the second experiments, the mouth of the cone, in the trumpet apparatus, was closed with a plate of thick tin, and both instruments were protected by a parcelling of old canvas and rope-yarn, at the part in contact with the surface of the water. In these experiments the cone was placed at right angles to the stem, and the mouth directed toward the sound. The distances were measured by the interval elapsed between the observed flash and re-

port of a pistol. At the distance of 1400 feet, the conical instrument was found considerably superior to the cylindrical, and at greater distances the superiority became so decided, that the latter was abandoned in all subsequent experiments. At the distance of 5270 feet, the bell was heard with such distinctness as left no doubt that it could have been heard half a mile further.

The sounds are stated in the paper to have been less intense than those in air, and seemed to be conveyed to less distances. The character of the sound was also wholly changed, and, from other experiments, it appeared that the blow of a watchmaker's hammer against a small bar of iron gave the same sharp tick as a heavy blow against the large ship's bell. It is well known that Franklin heard the sound of two stones struck together under water at half a mile distance; yet two of the boat's crew, who plunged their heads below the water, when at a somewhat less distance from the bell, were unable to hear its sound.

On the 24th of August, the vessel having proceeded to the Gulf Stream, experiments were made with the view for which the voyage was undertaken; that is, to ascertain whether an echo would be returned, through water, from the bottom of the sea. Some difficulties were at first presented in exploding the gun under water, but these were at length overcome. The hearing-tube was ballasted so as to sink vertically in the water. The observers then went, with this instrument, to a distance of about 150 yards from the vessel, and the petard was lowered over the stern, about three fathoms under water, and fired. The sound of the explosion, as heard by Mr. Bonnycastle, was two sharp distinct taps, at an interval of about one-third of a second. Two sounds, with the same interval, were also clearly heard on board the brig; but the character of the sounds was different, and each was accompanied by a slight shock. Supposing the second sound to be the echo of the first from the bottom of the sea, the depth should have been about 160 fathoms.

To ascertain the real depth, the sounding was made by the ordinary method, but with a lead of 75 pounds weight, and bottom was distinctly felt at 550 fathoms, or five furlongs. The second sound could not, therefore, have been the echo of the first; and this was proved, on the following day, by repeating the experiment in four fathoms water, when the double sound was heard as before, and with the same interval.

The conclusion from these experiments is, either that an echo cannot be heard from the bottom of the sea, or that some more effectual means of producing it must be employed.

Dr. Hare suggested the expediency of employing the Galvanic fluid to fire gunpowder below the surface of water, in experiments similar to those of Professor Bonnycastle.

Fusion of Platinum.—Dr. Hare laid before the society a specimen of platinum, weighing between twenty-two and twenty-three ounces, being part of a mass of twenty-five ounces, fused by him in May last, by means of his compound blowpipe.

Tornado.—Dr. Hare also mentioned that he had observed, during a recent tornado at Somerset, Mass., various circumstances, which he detailed, all leading to the conclusion that a hiatus or place of rest exists at the centre of motion of the tornado.

October 5.—Mr. Du Ponceau, President, in the Chair.

Solar Eclipse.—The Committee on the solar eclipse of the 18th of September, made a further Report in part.

This portion of the report embraced the observations made in the vicinity of Philadelphia, of which the following are the principal results, arranged in the order in which they were received, and, with one exception, in mean time of the place of observation; the longitudes being reckoned from Greenwich.

No. 16, by Robert Treat Paine, Esq., at the west front of the Capitol, Washington. Latitude 38° 53′ 23″, as determined by Mr. Paine, with his Troughton's sextant. Longitude 5*h* 8*m* 6*s* west. With 3½ feet equatorial, green screen glass. Time by three chronometers, regulated by eastern and western altitudes of sun and stars, with his Troughton's sextant.

	h	*m*	*s*
Beginning,	3	6	9.58
Formation of ring,	4	24	28.15
Rupture of ring,	4	30	18.55
End,	5	39	54.89
Duration of eclipse,	2	33	45.31
Do. of ring,		5	50.40

"The ring formed instantaneously, and broke nearly so. No beads were seen, nor the dark lines mentioned by Mr. Bailey, nor the light round the moon, although all were looked for. No distortion of the moon's limb could be seen, and the cusps of the sun, before the ring formed, were as sharp as needles."

No. 17, by Lieut. Gillies, U. S. N., at the Marine Observatory, Washington City, N. 8″, W. 0.08*s* in time, from the Capitol, with a 3½ feet achromatic, green screen glass, power 50. Astronomical clock regulated by a five feet transit instrument.

	h	*m*	*s*
Beginning,	3	6	10.4
Formation of ring,	4	24	28.4
Rupture of ring,	4	30	18.9
End,	5	39	56.4
Duration of eclipse,	2	33	46.0
Do. of ring,		5	50.5

"At beginning of eclipse, limbs sharp and well defined. The same at formation and rupture of the ring, only in the former the light seemed to flash round the moon's limb." Two detached, arched portions of the ring were seen separated from the cusps, "while the space between presented points of light (beads) only."

No. 18, by Prof. Elias Loomis, at the Observatory of the Western Reserve College, Ohio. Latitude 41° 14′ 42″ N. Longitude 5*h* 25*m* 35*s* W. With a five feet equatorial, mounted on a stone pier under a revolving dome, with yellow screen glass, power 150, nearly. Astronomical clock regulated by a 20 inch transit circle by Simms.

Beginning 14*h* 27*m* 26.7*s* siderial time.

Other phases lost by clouds.

Nos. 19, and 20, by J. Gummere and his son S. J. Gummere, at the Haverford School Observatory, Chester County, Pa. Latitude 41° 1′ 12″ N.

Longitude 5*h* 1*m* 16*s* W. With two 3¼ feet telescopes by Tulley, with red screen glasses, powers 75, nearly. Astronomical clock regulated by a Dolland's portable transit instrument.

	h	*m*	*s*
Beginning,	3	12	17.2
Formation of ring,	4	30	29.2
Rupture of ring,	4	34	44.8
End,	5	44	28.7
Duration of eclipse,	2	32	11.5
Do. of ring,		4	15.6

Arch of faint light, with brush in centre, seen before the formation of the ring. Arch seen after rupture, brush of light not recollected. Formation and rupture of the ring, by broken portions of the sun's border, several in number, not round like beads, but arched portions of the ring. These continued several seconds, and then suddenly united in the first instance, and separated in the last, without, however, exhibiting the dark lines figured by Bailey.

Nos. 21 and 22, by Charles Wister and his son Caspar E. Wister, at the Observatory of the former, Germantown. Latitude 40° 1′ 59″. Longitude 2.7*s* in time west of the State House. With a 2½ feet achromatic and a 2 feet Gregorian reflector. Astronomical clock regulated by a 3 feet transit instrument.

	C. Wister.			C. E. Wister.		
	h	*m*	*s*	*h*	*m*	*s*
Beginning,	3	12	55.4	3	12	54.4
Formation of ring,	4	31	9.4	4	31	8.4
Rupture of ring,	4	35	18.4	4	35	18.4
End,	5	45	8.4	5	45	7.4
Duration of eclipse,	2	32	13.0	2	32	13.0
Do. of ring,		4	9.0		4	10.0

"The lucid points and dark intervening spaces corresponded closely to Bailey's description."

No. 23, by John Griscom. Latitude 9.7″ N. Longitude 0.3*s* in time west of the Observatory of Haverford school. With a 3½ feet Dollond achromatic, power 80.

	h	*m*	*s*
Beginning,	3	12	18.6
Formation of ring,	4	30	31.6
Rupture of ring, (not reported.)			
End,	5	44	26.6
Duration of eclipse,	2	32	8.6
Do. of ring, (not reported.)			

No. 24, by Prof. James Hamilton, of Burlington, New Jersey. Latitude 40° 5′ 10″ N., 69.1*s* in time east of State House, Philad.—With a five feet achromatic, power 80. Clock regulated by equal altitudes with a sextant.

	h	*m*	*s*
Beginning,	3	14	23.7
Formation of ring,	4	32	32.6
Rupture of ring,	4	36	19.6

	h	*m*	*s*
End,	5	46	8.5
Duration of eclipse,	2	31	44.8
Do. of ring,		3	47.0

"The phases of the ring are the perfect formation and perfect rupture, without reference to beads. No dark lines seen."

October 19.—Dr. CHAPMAN, Vice President, in the Chair.

Solar Eclipse.—The Committee on the solar eclipse of the 18th of September, made a further Report in part, comprising the following observation:—

No. 25, by F. R. Hassler, Esq., at Weasel Mountain, N. J., latitude 40° 52′ 35″, approximate longitude 4*h* 57*m* 25.7*s* W., being one of the stations of the coast survey, with telescopes of the large theodolite, powers 116 and 151.

	h	*m*	*s*
First contact,	3	15	56.98
Inner contact,	4	35	57.09
End,	5	47	13.10
Duration of eclipse,	2	31	16.12
Do. of ring,			1.00

From a drawing, accompanying Mr. Hassler's communication, it appears that several broken portions of the ring, or beads of light, for a second only, extended from cusp to cusp, presenting a most beautiful appearance. During the rest of the eclipse, except this single second, the cusps were dull and rounded off at the end.

Natural History of Coal.

It is now universally allowed, that coal is the product of decomposed vegetable matter; and there are two hypotheses as to the mode in which it is brought together in such vast quantities. Deluc, Brongniart, Dr. Macculloch, and Mr. Hutton, of Newcastle, think that the plants generally grew and died on the spot where the coal exists, and that a bed of coal was analagous in its origin to a peat-bog. The other hypothesis (which is perhaps more generally received) assumes that the vegetable matter was swept from the land into estuaries or lakes by inundations and streams, as the trunks and branches of the trees, with roots and foliage, are carried down by the Mississippi and St. Lawrence in North America. The difficulty of accounting for the immense accumulations of vegetable matter spread over such extensive areas, is great in either way. But without going into the comparative merits of the two hypotheses, the former is assumed as true, for the purpose of illustration, in the following remarks:—

Coal was analogous in its origin to modern peat, and each bed was most probably formed on an extended surface of marshy land, covered with a rank vegetation. The finest caking coal Mr. Hutton considers as a crystaline compound, whose constituents had been in a state of solution; but slate coal and cannel coal often bear distinct impressions of plants. The new method of cutting minerals into slices so thin as to be transparent, of which Mr. Witham has made so happy a use, has been applied to coal; and by examining these with the microscope, the vegetable structure has been detected

where no external trace of it was visible. In cannel coal it exists throughout the whole mass, while the fine coal retains it only in small patches, which appear, as it were, mechanically entangled. Among other indications of the ligneous origin, tubes have been discovered filled with a yellowish resinous matter, which is the most volatile part of the coal, being what is first driven off by heat. All coal, therefore, had originally existed in the state of plants or trees. About three hundred species have been found in the sandstone and shale of the coal measures; and the greater part of these probably exist in the coal itself, though the tenderness and opaqueness of the material render it difficult to detect them by examination. The three hundred species are all extinct. About two-thirds of them are ferns; the others consist of large Coniferæ (allied to the pine,) of gigantic Lycapodiaceæ, of species analogous to the Cactæ and Euphrobiaceæ, and of palms. The plants indicate a moist climate, as hot as that of the tropics; and this holds true in the coal plants, not only in England, but at Melville Island within the polar circle. Dr. Hutton thought that the vegetables had been carbonized by heat; but Dr. Macculloch contends, on good grounds, that the change has been effected solely by water and pressure, and that by these agents peat is capable of conversion into coal. In the coal, therefore, familiarly used in our houses, we have the forests of primeval times, deprived of their watery and volatile parts, but preserving all their combustible matter, laid up for our use, as it were, in vast cellars under our feet, closely packed, and protected from air, rain, and floods, by a solid covering of rock and soil.

The other hypothesis is thus explained by Professor Phillips, with reference to the coal formation of Yorkshire. The alternating beds he attributes to alternating currents from different points of the compass, charged with different sediments, and passing into a great estuary or lake. Lime, he thinks, was transported by the marine currents from the south-east, because the limestone beds are thickest in that direction, and thin off towards the opposite point: argillaceous sediment was swept in by a river from the west, the shales being thickest in that direction; while sand and floating wood were drifted from the north, the beds of coal and sandstone being thickest in that direction.

This hypothesis, like the other, involves various difficulties, of which two may be mentioned. Of the four currents bearing wood, sand, clay, and lime, how did it happen that three so generally suspended their action, while the fourth was operating? Again, supposing the wood to be floated from the north by a river which inundated its banks like the Mississippi, it is plain that such a stream could carry off only a small part, probably not one thirtieth, of the spoils of the forest annually deposited in its hydrographical basin.

It follows, that to furnish materials for a bed of coal extending over a given space, the river must have drawn its waters from an area thirty times as large as would be required if the wood was carbonized where it grew, or the period must have been thirty times as long. But, looking to the extent (once much greater than it now is) of the coal formations in the north of England and Scotland, where is the continent to be found in which such a river could exist? Mr. Phillips, in fact, finds it necessary to admit, that the large tracts of land required to furnish the sediments of sand and clay, and the masses of vegetable matter, have disappeared in the northern and western oceans. The fossils of the coal measures are chiefly plants. They are most abundant in the shale, but are also found in the sandstone. They generally lie on their sides; but various examples have been found of trees standing erect, piercing through several beds, with their roots spread out, and so cir-

cumstanced as to lead to the conclusion that they have been converted into stone at the very spot where they grew. Fossil trees seldom exceed a few feet in length; but examples are cited of some twenty feet long, found in what is considered their native locality. Their roots are sometimes in sandstone, but more frequently in a bed of shale, which had originally consisted of fine mud, and formed the soil in which they grew. Trees which had been transported from their native seats are, however, infinitely more common, and these have been found of great length. A magnificent specimen was exposed in Craigleith quarry, in 1833. Its colour approaches to black; it is about three feet in diameter; and there were above twenty feet of its length exposed when I saw it in 1834. It has no branches, but the scars where branches had been inserted are well marked. It has been ascertained, by slicing, to be a Conifera of the genius Arancaria, of which living species exist in New Holland. Like its modern type the fossil tree wants those concentric rings which mark the annual additions made to the growth of pines. It penetrates the sandstone obliquely, at an angle perhaps of twenty degrees. —*Maclaren's Sketch of the Geology of Fife and the Lothians.*

Mining Review.

Optical Phenomena. Measurement of Intensity of Light. British Association of Birmingham, August 26th.

Prof. Daubeny exhibited the model of an apparatus, by means of which, in a more complete condition, he hoped to obtain a numerical estimate of the intensity of solar light at different periods of the day, and in different parts of the globe. The contrivance consisted of a sheet of photogenic paper, moderately sensible, rolled round a cylinder, which, by means of machinery, would uncoil at a given rate, so as to expose to the direct action of the solar rays, for the space of an hour, a strip of the whole length of the sheet, and of about an inch in diameter. Between the paper and the light was to be interposed a vessel, with plane surfaces of glass at top and bottom, and in breadth corresponding to that of the strip of paper presented. This vessel, being wedge-shaped, was fitted to contain a body of fluid of gradually increasing thickness, so that, if calculated to absorb light, the proportion intercepted would augment in a gradually increasing proportion from one extremity of the vessel to the other. Hence it was presumed that the discoloration arising from the action of light would proceed along the surface of the paper to a greater or less extent, accordingly as the intensity of the sun's light was such as enabled it to penetrate through a greater or lesser thickness of the fluid employed. In order to register the results, nothing more was required than to measure, each evening, by means of a scale, how many degrees the discoloration had proceeded along the surface of the paper exposed to light, during each successive hour of the preceding day. To render the instrument self-registering, some contrivance for placing the paper always in a similar position with reference to the sun, must of course be superadded. The object of this contrivance differed from that aimed at by Sir J. Herschel in his Actinometer, being intended as a measure of the aggregate effect of the solar intensity at the period (be it long or short) during which the paper was submitted to its influence; whereas the Actinometer merely measures the intensity at the moment the observation is made. The interposition of an absorbing fluid has at least this advantage, that it enables the observer to estimate the relative intensity by marking the point

at which the paper ceases to be discolored, of which the eye is able to judge more exactly than it could do of the relative darkness of shade which might be produced on paper exposed unprotected to light of different degrees of brilliancy.

Mr. Jackson thought that a Heliostat, for throwing the reflected light of the sun upon the instrument, would be objectionable; and suggested, in preference, that the Heliostat should rather turn the instrument to the sun, which he considered could be effected with equal ease.—Dr. Daubeny assented.—Prof. Forbes only first saw the instrument yesterday; he therefore could not speak with much confidence, but must own his first impressions were not very sanguine of its ultimate success. One objection was, the difficulty, if not impossibility, of procuring prepared or photogenic paper of exactly similar sensibility; and unless this were done, not even the observations of the same person, made at different times, could be compared, much less could any comparisons be made of the results of different observers. Another objection was the difficulty of observing where the discoloration extended to, as the shading off would be so gradual; so that different persons would come to different conclusions, according to the goodness or badness of their sight, upon the very same sheet of register paper. A third objection was, that the facts would be so complicated, that he much feared whether any scale could be formed; for not only were the quantities of light which would be permitted to pass through a wedge-shaped mass of fluid, such as Dr. Daubeny proposed, diminished, in a geometrical proportion, as its thickness increased arithmetically, but it had now been clearly established by the researches of Melloni, Fresnel, and others, that the portion of light which had already passed through a portion of any medium, was in a state for passing with greater ease, or in a greater relative proportion, through equal portions of the remainder. Unquestionably, self-registering instruments of all kinds were highly desirable, and an instrument fitted to perform what Dr. Daubeny proposed would be both interesting and valuable; and he thought the suggestions valuable, even supposing difficulties such as he alluded to should be found to exist.—Dr. Daubeny said, that, as to one of the objections, Sir John Herschel had informed him that any quantity of equally sensible photogenic paper could be obtained; as to the scale, the indications were not intended to furnish absolute, but only relative, results.

Athenæum.

Mechanics' Register.

The Patent Safety Fuze.

Before the invention of the Patent Safety Fuze, the loss of life in the Cornish mines was frightful. No one, unless entirely destitute of benevolence, could then take up a newspaper without having his soul harrowed with the heart rending accounts of mutilation and loss of life, arising from premature explosions in blasting. Nearly every week the shocking details were before us. To one, the light of heaven was no longer a blessing,—another, passed the remainder of his life a maimed man, while many left widows and children to helpless lamentation and starving want. The Safety Fuze was introduced—mine after mine adopted it—and, in proportion as the circle of its use became wider, the accidents within that circle became fewer. At the present time being used in nearly all the mines in Cornwall,

nearly all the accidents from premature explosions have ceased. The Fuze is about three-sixteenths of an inch in diameter, and has the appearance of varnished cord. Its advantages over every thing previously used are many and striking. The time of the labourers is saved; no needle being used, no time is lost in priming, making touch paper, &c. The Fuze is placed in the charge, tamped up, and immediately fired. It burns so slowly (about thirty inches a minute) as to afford ample time for the labourers to retire. It is certain—not one in a thousand fails—with care, not one in a million. Disregarding the saving in time and certainty (and this is immense), the whole expense of the Fuze is saved in gunpowder alone. Owing to the size of the nail-hole in the common process, much of the power of the powder escapes; the whole of this is saved, and it amounts, as proved by experiment, to fully one-fifth of the gunpowder used. It is equally applicable to wet ground as to dry; for conveying fire 200 feet under water as through the air, or beneath the earth. Combining, then, certainty, economy, and safety, the patentees offer the Safety Fuze to the world as one of the most useful inventions of the nineteenth century.—*North Derbyshire Chronicle.*—[We readily add our testimony to that of our contemporary, as to the advantages attendant on the use of the Safety Fuze, having, in every instance where we are interested (so far as we have had the opportunity), enforced its application, as not only tending to, and we might also say ensuring, the safety of life, but as being more economical. We wish that the press in the mining districts would direct their attention to this important subject.—*Ed. Mining Journal.*]

Cheap Hygrometers.

Very many plants, and parts of plants, are sensitively hygrometric, and foreshow the changes of weather. One of the simplest and most certain of hygrometers is a well twisted cord saturated with salt, and stretched tight along a wall, with a plummet suspended from the centre. And a most curious automaton may be made by glueing deal boards together edgeways, and sawing off a strip across the grain; through this drive four nails, two at each end, all inclining the same way; place it in a large empty room, and and as the weather changes, the fore-end will advance, and then draw the hinder part after it, and so crawl across the room, in the manner of an earthworm, which is furnished in like manner with four rows of little hooks pointing to the tail. Farm. Mag.

Improvement in Gloves and Stockings.

The hosiers of Nottingham and Leicester are making gloves and stockings having bands of Indian-rubber web knitted at the wrists, and under the knees instead of garters; a patent has been obtained for the invention, and licences, at £5 a-year each, are sold to the frame-work knitters.—*Nottingham Review.*—[In the Rolls Court on Saturday last an injunction was applied for by the London Caoutchouc Company—as the proprietors of Sievier's patents, to restrain these Nottingham manufacturers from using the elastic web in this way. The matter was partially compromised by the infringers paying the patentees 10*l.* as an acknowledgment of their right—and on being permitted to sell the stock of gloves and stockings they had on hand.] Mech. Mag.

LUNAR OCCULTATIONS FOR PHILADELPHIA, JANUARY, 1840.					Angles reckoned to the right or westward round the circle, asseen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
19	9	48	Im. q Cancri	6	105°	53°
19	10	47	Em.		207	159
20	8	34	Im. α Leonis	1	24	332
20	9	18	Em.		290	238
23	16	17	Im. χ Virginis	6	57	57
23	17	40	Em.		221	201

Meteorological Observations for July, 1839.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	65	83	30.00	30.00	S.W.	Moderate.		Lightly cloudy—clear.
☽	2	68	79	.00	29.90	S.S.E.	do.	.15	Cloudy—rain.
	3	67	80	29.70	.70	W.	do.		Cloudy—clear.
	4	65	82	.70	.75	W.	do.		Clear—do.
	5	58	74	.70	.70	N.	do.		Clear—lightly cloudy.
	6	59	75	.90	.85	N.	do.	.8	Clear—rain.
	7	59	68	.80	.85	W.	do.		Clear—do.
	8	62	79	.65	.85	W.	do.		Clear—do.
⊗	9	62	82	.90	.90	W.	do.		Clear—do.
	10	66	86	.90	.85	W.	do.		Clear—do.
	11	71	86	.63	.55	S.S.W.	Calm.	.14	Cloudy—rain.
	12	66	77	.55	.55	S.S.W.	do.		Cloudy—clear.
	13	62	77	.90	.75	W.	Moderate.		Clear—do.
	14	66	77	.75	.70	W.	Brisk.		Cloudy—do.
	15	62	76	.50	.50	W.	Moderate.		Clear—cloudy.
	16	62	78	.50	.50	W.	do.		Clear—do.
	17	62	78	30.10	30.05	N.W.	do.	.7	Partially cloudy—rain.
☾	18	63	80	.10	.13	S.W.	do.		Clear—do.
	19	67	86	.10	.10	S.W.	do.		Clear—do.
	20	73	83	.05	.00	S.W.	Brisk.		Cloudy—lightly do.
	21	72	80	29.90	29.85	S.W.	Moderate.	.30	Rain—cloudy.
	22	72	84	.80	.80	W.	do.		Partially cloudy—do.—do.
	23	72	85	.80	.83	W.	do.	.40	Drizzle—rain.
	24	70	84	.86	.86	W.	do.		Clear—do.
⊙	25	72	80	.80	.80	S.W.	do.	.7	Cloudy—clear—rain.
	26	70	85	.65	.70	N.W.	do.		Clear—do.
	27	72	85	.80	.83	W.	do.		Clear—do.
	28	68	81	.83	.83	W.	do.		Cloudy—do.
	29	70	76	.83	.83	S.W.	do.	.1	Cloudy—drizzle.
	30	68	84	.80	.80	S.W.	do.		Cloudy—do.
	31	73	84	.80	.75	S.W.	do.		Cloudy—do.
	Mean	66.58	80.64	29.82	29.81			1.92	

	Thermometer.		Barometer.
Maximum height during the month.	86.	on 3d, 10th, 11th, 19th.	30.13 on 18th.
Minimum " "	58.	5th.	29.50 15th, 16th.
Mean	73.61.		29.815

METEOROLOGICAL REPORT

FOR THE STATE OF PENNSYLVANIA,

Collated from returns made to the Committee on Meteorology of the Franklin Institute of the State of Pennsylvania, for

NOVEMBER, 1839.

	County.	Town.	Observer.	Thermometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Register. Lowest.	Mean.	Days omitted.	Barometer. 7, A. M.	2, P. M.	9, P. M.	Maximum.
1	Philadelphia,																
2	Montgomery,																
3	Bucks,	Newtown,	L. H. Parsons,	32.93	46.95	34.48	63.50	15.	38.12	.	10.	25.53	.	30.05	30.05	30.05	30.64
4	Lehigh,																
5	Northampton,																
6	Monroe,	Stroudsburg,	A. M. Stokes,	30.40	42.96	33.58	54.	10.	35.65	3⅔	.....	.....	.	29.59	29.55	29.54	30.15
7	Pike,																
8	Wayne,																
9	Susquehanna,	Silver Lake,	E. W. Rose,	28.23	37.47	32.33	50.	4.	32.68	.	3.	24.97	.	28.02	27.96	27.93	28.58
10	Luzerne,																
11	Schuylkill,	Pottsville,	John Porter,														
12	Berks,	Reading,	C. F. Egelmann,	33.50	42.00	35.30	55.	13.	36.93	.	....	.....	.	28.85	29.83	29.85	30.46
13	Chester,																
14	Delaware,	Haverford,	Haverford School,	33.98	42.27	36.77	59.	15.50	37.67	.	16.50	32.85	3	29.71	29.73	29.69	30.35
15	Lancaster,	Lancaster,	Conservatory of Arts,	32.88	45.72	36.68	60.	14.50	38.43	1	14.	31.62	.	29.56	29.51	29.54	30.16
16	York,	York,	Calvin Mason,	40.18	44.29	38.48	60.	21.	40.98	3	16.	30.83	3	29.64	29.65	29.66	30.20
17	Lebanon,																
18	Dauphin,																
19	Northumberland,	Northumberland,	Andrew C. Huston,	31.78	43.13	34.63	55.50	11.	36.51	.	5.	24.30	.	29.48	29.46	29.48	30.13
20	Columbia,	Danville.	C. H. Fricke,														
21	Bradford,																
22	Tioga,																
23	Lycoming,																
24	Union,																
25	Mifflin,	Lewistown,	J. Culbertson, M. D.,														
26	Juniata,	Mifflintown,	J. A. Rinkead,	31.60	45.29	33.36	56.	11.	36.75	2	....	.....	.	29.56	29.49	29.51	30.24
27	Perry,																
28	Cumberland,	Carlisle,	Prof. W. H. Allen,	31.03	42.97	34.55	59.	9.	36.18	⅛	9.	28.80	.	29.47	29.46	29.47	30.11
29	Adams,	Gettysburg,	Prof. M. Jacobs,	31.94	43.18	34.87	56.50	12.50	36.66	.	12.50	28.74	.	29.44	29.45	29.44	30.
30	Franklin,	Chambersburg,															
31	Huntingdon,																
32	Centre,	Bellefonte,	John Harris,	28.71	40.11	31.40	54.	6.	33.41	3	5.	23.12	6	29.30	29.30	29.33	30.
33	Potter,																
34	M'Kean,	Smithport,	Richard Chadwick,	28.43	33.93	27.83	48.	6.	30.06	⅛	3.	23.13	.	28.13	28.11	28.13	28.68
35	Clearfield,																
36	Cambria,	Ebensburgh.	Richard Lewis.	29.23	36.14	31.07	49.	5.	32.15	⅘	5.	22.78	12	27.79	27.84	27.79	28.80
37	Bedford,	Bedford,	A. King,	32.62	42.14	32.63	54.	10.	35.80	.	....	....	.	29.21	29.15	29.20	29.80
38	Somerset,																
39	Indiana,	Indiana,	Richard White,	38.13	41.27	39.90	56.	15.	39.77	.	9.	29.37	.	28.59	28.55	28.61	29.20
40	Jefferson,	Rose Cottage,	C. C. Gaskell,														
41	Warren,																
42	Venango,																
43	Armstrong,																
44	Westmoreland,																
45	Fayette,	Uniontown,	Rev. J. P. Wiethers,	32.97	41.03	36.50	58.	10.	36.83	12⅓	....	....	.	29.09	29.06	29.14	29.68
46	Green,																
47	Washington,																
48	Allegheny,																
49	Beaver,																
50	Butler,	Butler,	Jacob Mechling,	32.18	39.50	35.87	54.	6.	35.85	.	...	....	.	....	....	....	....
51	Mercer,																
52	Crawford,																
53	Erie,																

LUNAR OCCULTATI
JA

Day.	H'r.	Min.	St
19	9	48	Im. q C
19	10	47	Em.
20	8	34	Im. a L
20	9	18	Em.
23	16	17	Im. χ V
23	17	40	Em.

Meteoro

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Bar Sun rise
				Inch
☽	1	65	83	30.
	2	68	79	.
	3	67	80	29.
	4	65	82	.
	5	58	74	.
	6	59	75	.
	7	59	68	.
	8	62	79	.
⊗	9	62	82	.
	10	66	86	.
	11	71	86	.
	12	66	77	.
	13	62	77	.
	14	66	77	.
	15	62	76	.
	16	62	78	.
	17	62	78	30.
☾	18	63	80	.
	19	67	86	.
	20	73	83	.
	21	72	80	29.
	22	72	84	.
	23	72	85	.
	24	70	84	.
☉	25	72	80	.
	26	70	85	.
	27	72	85	.
	28	68	81	.
	29	70	76	.
	30	68	84	.
	31	73	84	.
	Mean	66.58	80.64	29 .

Maximum height during the m
Minimum " "
Mean

Thermometer.										B		
						Register.						
7, A.M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Lowest.	Mean.	Days omitted.	7, A. M.	2, P. M.	
.93	46.95	34.48	63.50	15.	38.12	.	10.	25.53	.	30.05	30.05	30
.40	42.96	33.58	54.	10.	35.65	3⅓	.....	.....	.	29.59	29.55	29
.23	37.47	32.33	50.	4.	32.68	.	3.	24.97	.	28.02	27.96	27
.50	42.00	35.30	55.	13.	36.93	.	....	.....	.	28.85	29.83	29
.98	42.27	36.77	59.	15.50	37.67	.	16.50	32.85	3	29.71	29.73	29
.88	45.72	36.68	60.	14.50	38.43	1	14.	31.62	.	29.56	29.51	29
.18	44.29	38.48	60.	21.	40.98	3	16.	30.83	3	29.64	29.65	29
.78	43.13	34.63	55.50	11.	36.51	.	5.	24.30	.	29.48	29.46	29
.60	45.29	33.36	56.	11.	36.75	2	....	.....	.	29.56	29.49	29
.03	42.97	34.55	59.	9.	36.18	⅛	9.	28.80	.	29.47	29.46	29
.94	43.18	34.87	56.50	12.50	36.66	.	12.50	28.74	.	29.44	29.45	29
.71	40.11	31.40	54.	6.	33.41	3	5.	23.12	6	29.30	29.30	29
.43	33.93	27.83	48.	6.	30.06	⅓	3.	23.13	.	28.13	28.11	28
.23	36.14	31.07	49.	5.	32.15	⅔	5.	22.78	12	27.79	27.84	27
.62	42.14	32.63	54.	10.	35.80	.	....	....	.	29.21	29.15	29
.13	41.27	39.90	56.	15.	39.77	.	9.	29.37	.	28.59	28.55	28
.97	41.03	36.50	58.	10.	36.83	12⅓	....	....	.	29.09	29.06	29
.18	39.50	35.87	54.	6.	35.85	.	...	....	.	....	....	..

Barometer.							Weather.							Winds.																Hygrometer.					
7, A. M.	2, P. M.	9, P. M.	Maximum.	Minimum.	Mean.	Days omitted.	Clear.	Cloudy.	Days omitted.	Rain.	Snow.	Rain and Snow.	Thunder Showers.	Rain in inches.	North.	N. N. E.	N. E.	E. N. E.	East.	E. S. E.	S. E.	S. S. E.	South.	S. S. W.	S. W.	W. S. W.	West.	W. N. W.	N. W.	N. N. W.	Calm.	Days omitted.	Dew-point.	Days omitted.	Diff. therm. and dew point.	Wet Bulb.	Days omitted.	No. of Report.
30.05	30.05	30.05	30.64	29.49	30.05	.	13 1/5	16 2/3	.	....	....	....	..	4.160	6 2/3	.	1 2/3	.	2 1/2	.	1/3	.	5	.	6 2/3	.	2 2/3	.	4 2/3	.	.	.	38.47	.	.....	....	.	910
29.59	29.55	29.54	30.15	29.05	29.56	3	6 1/2	20 2/3	3	....	....	....	..	4.000	4 1/3	1/3	2/3	.	3 1/3	1/3	1 1/2	.	.	.	2	1/3	6 2/3	1	5	.	.	4 2/3	....	.	.....	45.44	21	893
28.02	27.96	27.93	28.58	27.45	27.97	.	10	20	.	1	2	...	..	1.850	1 1/3	.	.	.	.	.	1 1/2	.	1 1/2	2/3	3 1/3	.	7 2/3	.	8 2/3	.	5 2/3	.	....	.	.....	....	.	887
28.85	29.83	29.85	30.46	29.27	29.84	.	9	21	.	4	....	1	..	2.191	1 2/3	.	2/3	.	.	2/3	2 1/3	.	.	.	2	.	3 1/3	2 1/3	15 1/3	.	1 2/3	.	....	.	.....	....	.	876
29.71	29.73	29.69	30.35	29.17	29.71	1/3	11 1/3	18 1/3	1/3	....	....	....	..	3.960	3	1/3	3	1/3	1/3	1/3	1 1/3	.	1/3	1/3	1 2/3	2/3	5 1/3	1 1/3	8 2/3	1/3	.	2 1/3	....	.	.....	41.92	17	878
29.56	29.51	29.54	30.16	28.92	29.54	1	14 1/3	15	2/3	4	1	1	..	2.230	2	1	2	1 1/3	1/3	1/3	2	2/3	1	1 2/3	1 1/3	1 1/3	4	3 2/3	4	1 2/3	.	1/3	30.37	2	.....	40.55	2	881
29.64	29.65	29.66	30.20	29.	29.65	3	.	.	.	....	....	....	..	2.379	2/3	.	7	.	2/3	.	1/3	.	.	.	.	.	1 1/3	.	16 2/3	1/3	.	3	28.68	3	.....	....	.	923
29.48	29.46	29.48	30.15	28.88	29.07	.	8 1/3	21 2/3	.	1	3	2	..	2.389	4 2/3	.	3	.	1	.	2/3	1/3	3 1/3	.	2 1/3	1/3	5 2/3	1/3	5 1/3	2/3	2 1/3	.	....	.	.....	47.90	.	946
29.56	29.49	29.51	30.24	28.58	29.52	2	9 2/3	14 1/3	6	....	....	....	..	1.990	.	.	3 2/3	.	1	.	1/3	.	1/3	.	2/3	.	1 1/3	.	10 2/3	.	10	2	....	.	.....	....	.	882
29.47	29.46	29.47	30.11	28.90	29.47	1/3	12 2/3	17	1/3	....	....	....	..	1.793	.	.	1/3	.	1	.	3 1/3	.	1 2/3	2/3	1 1/3	1 2/3	4 2/3	1	8	.	6	1/3	....	.	.....	....	.	875
29.44	29.45	29.44	30.	28.87	29.44	.	16	14	.	....	....	....	..	2.649	2 1/3	2	1 2/3	.	2/3	.	1/3	.	1 1/3	2	1 1/3	1/3	4	2	5	1	5 2/3	.	26.31	.	.....	37.42	.	889
29.30	29.30	29.33	30.	28.73	29.31	3 1/3	7	19 2/3	3 1/3	....	....	....	..	2.195	3	.	2 2/3	.	2/3	.	3 1/3	.	1/3	.	6	.	3 1/3	2/3	7	.	.	3	....	.	.....	....	.	900
28.13	28.11	28.13	28.68	27.60	28.13	1/3	8 1/3	21 2/3	.	3	1	2	..	2.360	.	.	1	.	5 1/3	.	1/3	.	2/3	.	3 1/3	.	7 2/3	.	10 2/3	.	.	1	40.84	24	.....	39.85	2	939
27.79	27.84	27.79	28.80	27.33	27.81	1/3	4 2/3	14 1/3	11	1	6	3	..	....	1/3	.	1 1/3	.	1 1/3	.	5 2/3	.	2	1/3	2 1/3	.	8	.	6 1/2	1 2/3	.	2/3	....	.	.....	....	.	879
29.21	29.15	29.20	29.80	27.78	29.19	.	10	19 1/3	2/3	5	5	3		....	2/3	1/3	.	.	.	1 1/3	2 1/3	2/3	3 2/3	1/3	1 2/3	1	3	2 2/3	6 2/3	1/3	1/3	5	....	.	.....	....	.	877
28.59	28.55	28.61	29.20	28.	28.58	.	10 1/3	19 2/3	.	8	2	....	..	2.546	.	.	1 2/3	.	2 1/3	.	1 2/3	.	.	.	2 2/3	.	5	.	5	.	11	.	....	.	.....	....	.	928
29.09	29.06	29.14	29.68	28.67	29.10	12	8	10	12	....	...	....	..	....	2/3	.	1/3	.	2/3	.	.	.	.	.	6 1/2	2/3	6 1/3	.	2/3	.	2 1/3	12	....	.	....	....	.	883
....	....	....	....	....	....	.	.	.	.	. .	....	....	..	3.502	.	.	1	.	8 1/3	.	1 2/3	.	2/3	.	6	.	11	.	1 1/3	.	.	.	....	.	....	....	.	880